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Vol. 52. January—June, 1914.

ABBREVIATIONS.—D. = Discussion; I. = Illustrated.
Names of authors are printed in *italics*.

JOSEPH W. PETERS, Secretary,
Association of Engineering Societies.

Editors reprinting articles from this JOURNAL are requested to credit the author, the JOURNAL OF THE ASSOCIATION, and the Society before which such articles were read.

ASSOCIATION
OF
ENGINEERING SOCIETIES.

ORGANIZED 1881.

Vol. 52. JANUARY, 1914. No. 1.

EDITORIAL.

With this issue of the Journal a new chapter is begun in the history of the Association of Engineering Societies. The Boston Society, with its 870 members, has withdrawn from the Association, having become strong enough to publish a Journal of its own, and the Engineers' Club, of St. Louis, with 390 members, has now assumed the mantle of leadership. On November 1st Mr. Joseph W. Peters, whose portrait is the subject of our frontispiece, was unanimously elected by the Board of Managers to the Secretaryship. On December 1st he reported for duty at the office of Mr. Fred Brooks in Boston and after familiarizing himself with the Association's business, returned to St. Louis and began preparations for issuing the January number from the Association's new headquarters. Detailed proposals for printing the Journal were solicited from the leading publishing houses of St. Louis. Very satisfactory competition was secured and a contract has been awarded to the Britt Printing & Publishing Co. at lower unit prices than were paid in Boston.

In view of the fact that the membership at large knows little of the Association's affairs the St. Louis Members of the Board of Managers desire to call attention to several other matters which have already been arranged and to some which are proposed, and in which the co-operation and support of all the members and constituent societies are earnestly desired.

The salary of the Secretary of the Association is fixed by the by-laws at $75.00 per month. Mr. Brooks, the retiring Secretary, paid out most of his salary to an assistant, and devoted most of his own time gratuitously. Realizing therefore that a satisfactory man could not afford to give his entire time at that salary the Engineers' Club of St. Louis voted to pay him an additional $50.00 per month from the Club's funds, making a total of $125.00 per month. In addition to this, the St. Louis Club furnishes quarters, heat, light, and telephone service without cost to the Association.

In regard to the membership of the Association: The number of Journals taken by a few of the Societies is considerably less than their membership, but the number of Journals taken is a measure of their financial assistance to the Association. These figures are given on the inside of the front cover. With the withdrawal of the Boston Society the total number of Journals taken is reduced from 2237 to 1366. The Detroit Society contemplates withdrawing from the Association on March 31st and if it should do so (which we hope it will not) the membership in the Association will be reduced to about 1100. This remainder is more than double the membership which the Association had during its early years, during which it published this Journal in a very creditable manner. In addition to this number we have 160 independent subscribers who are not affiliated with any of the societies in the Association.

It is proposed, however, to inaugurate an aggressive campaign for securing new societies to build up the membership of the Association. So far as the new management can learn this has never been done heretofore, and this is the first measure in which the co-operation of the entire membership is solicited. Among the engineering societies which have already been suggested for membership in the Association are Albany, Rochester, Troy, Syracuse, Harrisburg, Pittsburgh, Cincinnati, Louisville, Memphis, Kansas City, San Antonio, Seattle, Spokane and Idaho.

Information is desired in regard to other societies which might consider entering the Association, some of the advantages of which are given in the standing statement on the inside of the front cover. A society in the Association secures the publication of its papers and proceedings with but little effort on its part and at a reasonable cost for the amount of printed matter received. This is a great advantage to an organization in which

the members have very little time to devote to literary work and which has but a limited revenue. The incentive to prepare good papers is much greater when a large audience of national scope is available than when the audience is limited to the membership of the average local society. A perquisite of membership which is not as widely known as it should be, is that *the author of a paper is entitled to* 50 *reprints gratis.* It is obvious that the larger the Association can be made the larger and better the Journal may be made, as the entire income is expended in publishing the Journal. The larger the Association can be made the better the Journal becomes as an advertising medium, and this brings us to the next point.

The securing of advertising for the Journal has been neglected and the new Secretary proposes to take up this feature at once. Some new advertising has already been secured and the co-operation of all the readers is earnestly requested along this line, not only in suggesting possible advertisers but in patronizing our advertisers and in giving the Journal credit when answering advertisements. Any advertiser who could be secured for a purely local engineering journal will reach the same local readers in the Association's Journal, and in addition reach a much larger audience scattered throughout the country.

In conclusion we wish to say that the Journal of the Association is the Journal of the entire membership, and that it is the earnest desire of the Board of Managers to make it interesting and valuable to all of our subscribers. If the Journal is not what you would like to see it you are urged to send your suggestions to the new Secretary. We solicit such suggestions, and such as are made will receive serious consideration and be embodied, as far as possible, in the future issues of the Journal.

J. W. Woermann,
E. L. Ohle.
Edward E. Wall,
C. D. Purdon,
St. Louis Members of Board of Managers

Joseph W. Peters,
Secretary, Association of Engineering Societies.

THE STATUS OF THE ENGINEER.

By Edward E. Wall, Member Engineers' Club of St. Louis.

[Read before the Society, September 17, 1913.]

The status of the engineer has long been an aggravation to the members of our profession. In the first place engineering has had a long and weary siege even to be considered a profession among well informed people. It is not yet well-enough defined to be placed in the same class with Law, Divinity and Medicine, in the minds of the people at large. In the bucolic mind, the land surveyor and the engineer are one, and the locomotive runner or the man who runs the mill is looked upon as rather a higher type of engineer. To most people the name—engineer—applies to all men who operate steam or electric machinery or who survey land, equally with those who locate and construct railroads, design bridges, water-works, sewers, etc., and direct the multitudinous activities connected with the complex civilization of the twentieth century. They confuse the engineer proper with the mechanic, artisan and skilled laborer, holding us, perhaps, a little higher than the rest.

The public associate the engineer with construction as they see it going on before their eyes, in buildings, bridges, sewers, etc. They do not distinguish between the superintendent, who may be and often is an engineer, and the foreman of a gang. An instrument man giving elevations represents the typical engineer to them far more definitely than would a sight of the chief in his office working over his plans.

Engineers, themselves, do not definitely distinguish between the engineer that is to be and the engineer that is. Any instrument man or draughtsman may call himself an engineer without fear of contradiction.

There was once a foreman on construction at the waterworks, and he was not a good foreman at that, who posed among his acquaintances as an important member of the engineering force. A carpenter working on forms for concrete at the Chain of Rocks made his friends believe that he was engineer-in-charge of that construction; needless to say, his stay with us was short.

So long as we, ourselves, do not brand the impostor among us, how can we expect the layman to tell us apart? This raises the question—what are the qualifications of an engineer?

It is not enough that he shall be expert in calculation and abreast of the times in his knowledge of the results of all the research work being done in his special field. He must be practical, and by that I mean he must be able to fit his designs to the circumstances of the case in hand. His proposition must be so framed as to convince the community, corporation or individual that it is the best of all conceivable plans. In order to do this he must know men, and to a certain extent, be able to play upon and take advantage of their peculiarities and weaknesses. He must be able to impress business men, legislators, officials and also other engineers with the excellence of his proposals, and inspire them with respect for his knowledge and ability. In a few words, he must have good judgment—both of men and things. Good judgment presupposes experience, as well as thought and study. Experience, which has brought with it wisdom, is then the true touchstone to distinguish the engineer that is, from one who is not, or is yet to be.

Membership in a National Society should mean a certificate of ability and experience. Unfortunately this is not altogether true, although it is an indication that the individual has somewhere fulfilled his duties, at least, passably well. It is said that European engineers, who can write half a dozen initials after their names, are held in high esteem in their own country. But American colleges turn out graduates authorized to place A. B., A. M., B. S., C. E., etc., after their names, so rapidly that they are absolutely of no value and mean nothing.

Can you bring back to mind the picture of a youngster marching up to the rostrum on Commencement Day to be dubbed A. M., by his Alma Mater? Master of Arts! Such a spectacle is enough to cause the immortal gods to burst into uncontrollable and inextinguishable laughter.

Is it possible for the National Societies to educate the public to an understanding of the qualifications of a real engineer? Can the people be taught to see the value of the services of competent engineers, as compared to pretenders? Life is too short for us to wait until sad experiences teach the majority of mankind that the constructive work of the world should be en-

trusted only to competent hands. It is my belief that we should furnish correct information to the public, at least so far as to name men that are known to be able in their respective lines, if no more.

To the man on the street, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining Engineers, are in the same class as the Master Car and Locomotive Painters' Association, the American Foundrymen's Association, the National Brick Manufacturers' Association, the National Association of Cement Users, the Society of Automobile Engineers, the American Association of Demurrage Officers, etc., etc., the number of which is legion.

There are now, and have been in operation for years, organizations supported by various manufacturing interests for the sole purpose of educating people to see the value and demand the use of various manufactured materials, for example, brick, sewer pipe, reinforced concrete, cement pipe, lime products, paving materials, etc. This apparently benefits the manufacturers, or the scheme would be abandoned. Why, then, should not the National Engineering Societies maintain a Publicity Bureau for the distribution of the proper literature for the advancement of the profession? Every week technical journals publish a long list of engineering work about to be let, as well as projects proposed, giving the place and a brief account of the character of the work. It would be easy for a Publicity Bureau to get this advance information in time to do some missionary work in each locality, by distributing readable literature applicable to the case in hand emphasizing the value and necessity of employing capable engineers, furnishing a list of competent men with their records and holding up a few horrible examples of other communities that had suffered through the employment of persons not qualified to do such work. The Bureau would not undertake to say that such-and-such a one was incompetent, but would give names of some that were competent. Objection may be made that the list might omit engineers who were fully competent and who might live and practice in the territory where the work was contemplated. This could only happen at first before the Bureau completed its lists. The Bureau at the same time should use the local press to reach the citizens of each community.

Why not go farther, and through employed and capable press agents reiterate and impress upon the public mind, through the daily press, the importance of the engineers' work in construction, which is being done before their eyes every day?

Has any mention been made in our newspapers of the labor of the engineers, who made possible the erection of the Railway Exchange Building? Has the attention of the public been called to the fact that not only the foundations and steel frame, but the whole structure in detail, elevators, heating, lighting, water supply, etc., was carefully designed by engineers, who studied every detail of each part, in order to get the greatest efficiency with the greatest economy? The same may be said of all structures, but it is only on rare occasions, where the undertaking is extra hazardous, or of extraordinary magnitude, that the reporter makes a story of it by adding some amazing details of his own imagining to excite the wonder of his readers.

Practically everything of a communal nature that appertains to the comfort, convenience, luxury and necessity of the dweller in cities,—all, in fact, that makes possible the existence of cities, is the work of the engineer.

I quote from the editorial page of the *Engineering News*, "The only means that the public has of learning the qualities of the engineers, who are in its service, is from the stories written by the reporters for the local newspapers."

Local Engineering Societies can do much to aid in raising the public estimate of the profession. They might well take upon themselves the task of advising city administrations on engineering problems, as well as recommending names for engineering positions.

Last year the Cleveland Engineering Society made certain recommendations to the Mayor and City Council of that city, in regard to the water supply. The authorities made use of this assistance, publicly acknowledged its value and commended the Society very highly for its voluntary services. The Cleveland daily papers gave considerable space to this incident, citing it as an unusual exhibition of proper public spirit. Can anyone doubt that a multiplication of such instances would result in raising engineers in the estimation of the public?

Another instance, in which a local Society rendered signal service for its membership, was that of the New York Zoological

Society in the case of one of its members, who had been employed by the United States Government to do some expert work. A Congressional Committee, reporting an investigation, made serious charges against the scientist. The Society took up the matter, and after a thorough probing of the charges publicly exonerated the accused member. This action on their part was undoubtedly proper, and of benefit to all scientific and technical men. If similar action was promptly taken by the members of any profession in every case where the ability or competence of one of its members was questioned, that profession would soon command the respect and confidence of the entire public. The avidity of the press to criticise public men, and publish invidious and unreliable interviews and letters about them and their work, would grow less and less, and finally disappear.

The Junior Institution of Engineers of Great Britain has already made very substantial progress towards increasing the value of membership therein, by establishing and keeping a permanent Engineers' Register, in which a complete record of the professional career of each member is given. Its purpose is to assist members in improving their positions by systematically recording the particulars of each member's experience and technical training, and by introducing to employers of engineers, those members whose qualifications would fit them for the places open.

The success of this scheme is shown by the fact that on July 1st, this year, no applicant for a position was on the register, and what is more encouraging, the Secretary has, from the inauguration of the plan, received more requests for men from employers than he has had applicants for positions. Better salaries can be obtained when the place seeks the man, and the successful operation of this scheme depends on the reliability of the information supplied the employer by the Secretary. Confidence in the institution must be established, which must necessarily take some time.

The American Society of Civil Engineers has been urged to follow this example, but without any results up to date. There seems to be a growing dissatisfaction among the members of this Society, a feeling that it is not doing for the profession all that it might do. One member puts it this way: "The only

benefits of membership in the Society are the receipt of a few publications, the value of which is yearly deteriorating, and the honor of membership," to which he might have added, "which also is slowly losing its prestige."

It is the opinion of many members that the only way to increase its usefulness, restore confidence among its membership and exercise a beneficial influence—both for its members and the public at large—is to take an active and aggressive part in placing competent engineering on the high plane where it belongs. To do this means that it must not mince matters, but must condemn the bad as strongly as it praises the good. It must cease to be pleasant and amiable, ignoring mistakes, and turning its blind eye towards the innumerable and miserable abortions inflicted on the long suffering public by self-styled engineers.

The American Society of Civil Engineers and the other National Engineering Associations must take a step forward, and become active participants in the affairs of communities, cities, states and the nation, or else degenerate into mere social organizations similar to the Concatenated Order of Hoo-Hoos, and others of that ilk.

There has been a great deal of discussion during the last year or so of the proposition to license engineers by a State Board. This proposition to license engineers is intended to restrict the practice of engineering to those who have demonstrated in some degree their possession of knowledge and ability in that direction. The possession of a license will add in no way to the competence of the individual. It is difficult to see how a requirement for a license would eliminate very many, if any, who are actually living by engineering. Graduation from an engineering school of merit, under laws that have been suggested, would entitle the applicant to a license. Look over the lists of annual graduates, and see if a license law would thin us out to any very great extent. Again, to license an applicant simply as a civil or mechanical engineer, authorizing him to undertake any sort of work, from land surveying to bridge-building, from drainage to water purification, would be an absurdity on its face.

To attempt a graduated system of licenses for the various branches of engineering work would seem equally absurd and impracticable. The idea of licensing the engineer must have been a logical outcome of the notion that through legislation can

come universal order, round and square pins be set in their proper holes, and the machinery of the world at last run noiselessly and without friction.

Take the cases of lawyers and doctors cited as examples of the benefits of the license system. There are, no doubt, proportionately as many incompetent and irresponsible members of those two professions, as there are incapable persons calling themselves engineers in our own unlicensed ranks. Doctors' mistakes are buried, lawyers' failures are lost in the voluminous records of the higher courts, but the blunders of the self-styled engineer can neither be buried, lost or hidden, and he must stand before the world convicted by the work of his own hands.

By all means keep the incompetent out of our ranks. But let us do it ourselves, and not rely on a license system, which may and probably would be administered by ignorant or incompetent men. Our civil service may raise the average standard, but it also eliminates the best.

The status of an individual depends on his character, environment and education. No state law can control the private judgment of a community, nor force it to call a man an engineer if he is not one. Nor can any legislation be devised to raise the status of a profession unless the members of that profession set up a high standard of excellence and live up to it.

Engineers, like the rest of humanity, desire, fair, if not liberal compensation for their services. As a rule, they are somewhat less eager in the pursuit of the elusive dollar than the generality of mankind, which may account, in some degree, for the public belief that engineers are cheap. The small compensation paid engineers is a fruitful subject for discussion whenever they get together to swap experiences. The general life story of the typical engineer can be epitomized in a few words; he is employed to do certain work, finished his job and looks for another place, salary no object, provided it is enough to keep the wolf from the door. When he is employed he is usually so engrossed in his work that he expects the results to speak for him, and has little to say for himself. One problem follows another, and leaves him neither time nor inclination to cultivate the brazen art of advertising. He forgets, or else he never stopped to think, that in this age individuals are not valued by society at their intrinsic worth to the community.

A father writing to an eminent engineer for advice as to whether or no he should educate his son for an engineer, or place him in business received the following answer: "The chances of a graduate and a brilliant civil engineer to achieve financial success are so small. as compared to the world-wide opportunities of an intelligent business man, that there is no room for doubt as to the choice."

Universities seek to tempt the youth to take the engineering course by telling him how much salary he can command immediately on graduation. Even Harvard, the fountain-head of learning and culture on this continent, stoops to cajole the ingenuous youth by sending out the following: "The demand for sanitary engineers is continuous and increasing. There is little doubt but that men who enter this field will find useful service and a competent livelihood."

But what seems like riches to the youth, ten or twenty years later is poverty to the man.

The total engineering expenses for the water supply of Dallas, Texas, was less than two per cent of the cost of the work. Nearly one-half of this amount was paid to consulting engineers merely for passing on plans, leaving less than one per cent for surveying, designing, draughting and superintendence of construction.

Lately an attempt has been made to tabulate engineers' salaries and draw therefrom a generalization, showing the financial value of engineering as a profession. The figures were compiled from data obtained in and around New York City. His average yearly salary is placed at $1920.00, his annual expense at $1,500.00, leaving a net saving of $420.00, which is estimated at being 7.2 per cent of the cost of his living and education from his birth to graduation.

The young man, just out of college, usually has expended all his resources in completing the course of study, and in many cases has worked his way. Being without capital he must find work and accept whatever salary he can get. This is a perfectly proper condition of things for the youth at the beginning of his career. He must win his spurs. But he should not have to meet this state of affairs for the rest of his life. After he has had years of experience he should not still be obliged to hawk his services from office to office until he is glad to accept any offer. Engineers, themselves, are largely to blame for this lamentable condi-

tion. Chief engineers of corporations endeavor to hire engineering help at the lowest possible wage, in order to make a record for economy, and thereby enhance their own value in the eyes of their employers. Municipal engineers declare that they are limited by law to certain fixed salaries.

Consulting and contracting engineers claim that competition forces them to keep their overhead expenses as low as possible, hence they can only pay the lowest market prices for assistants.

If we grant that there is some merit in all these explanations and excuses, the fact still remains that none of them have ever made any serious effort or joined in any movement to obtain a general advance in compensation for engineers. The chief engineer has not said to his Board of Directors, "It would be truer economy to pay better salaries to engineers, and thus obtain greater efficiency;" the municipal engineer has not said to the Assembly, "Gentlemen, you cannot obtain competent engineers for the salaries you propose;" the consulting and contracting engineers have not met and said, "We will no longer take work at so low a figure that we cannot afford to pay engineers decent salaries;" or, if any of them have uttered these or similar truths on occasion, they have not consistently and insistently repeated them so as to produce any visible effect.

And worst of all neither the national nor local engineering societies have recognized the fact that cheapening men ultimately means inferior work, which is bound to result in dragging down the standard of the profession. These societies spend most of their time and money in doing honor to those members who have won their way to the front or near it, and in attempting to standardize engineering practice from data gathered from all quarters, both of which are very laudable practices, calculated to benefit the individual engineer in his relations to his clients or employers, and add somewhat to his stock of information, but only in an indirect way and after a long lapse of time can it operate to raise the status of the engineer. The papers published by these societies often contain valuable information for engineers, and afford the authors an opportunity to exploit their own achievements. All of these things are of value, but are they appreciably raising the standard of the profession in the estimation of the public at large?

There is another fact that we must face squarely, that tends to lower the status of the engineer in this country, and that is the system we have of educating the engineer. What passes for an engineering education with us, as well as I can make out, would be looked upon among European engineers as a casual acquaintance with the basic principles of engineering. It is only our achievements that command their wonder and respect.

It is not uncommon for a foreign engineer to be able to read intelligently, and speak more or less perfectly one, two or more languages beside his own. How many of us can do so? Lately the acquisition of a knowledge of French or German, or both, has been strongly advocated as a growing necessity for the engineer. The argument is made that our ignorance of foreign practice, which is due to our inability to read their literature entails heavy industrial losses. We can only offer the excuse that our conditions demand action rather than research, and the time saved overpays the loss.

To master one foreign language so that it would be a valuable asset of an engineer's education, would require much time, which in the case of most of us could be put to much more valuable use in the study of technical literature published in our own language, as well as the study of our language itself, which few of us can use with correctness and certainty.

A professor of engineering asked one of his graduates who had been out of school for ten years if he could suggest any addition to the curriculum "Yes," said his former pupil, "Four years of English." No more appropriate reply could have been made.

The education of the engineer is conducted along too narrow a path, and is hurried too much. The same may be said of our whole scheme of education, despite our pride in it. A system of education laid out along the following lines would seem preferable: Start a child in the primary schools, in which the subjects taught would be somewhat fewer, and far more thoroughly learned than at present; follow up with a high school course, where only the fundamental branches of study would be most thoroughly ingrained in the pupil's mind; then let the youth have not less than four years in a private school, with only a limited number of pupils, but most excellent teachers, so that the personal association between teacher and pupil should lend interest and fascination to the general study of history, morals, economics, sociology, art, literature, philosophy and the humanities. At

no stage should education be allowed to become a race against time, but rather it should be a pleasant leisurely journey in company with the sages of all time, a journey whose end would be approached with reluctant feet, and arrived at with regret. Then at last let the student take up the special study of law, divinity, medicine, engineering or other specialty, and your educational system would turn out better specialists and better citizens.

Our incomplete and hurried education is largely responsible for many of our troubles. Engineering is taught too much on the order of Mr. Gradgrind's school in Dickens' novel, Hard Times, where only facts were taught. "Facts alone are wanted in life. Plant nothing else, and root out everything else," said Mr. Gradgrind. So that the tendency of the education and practice of engineers in this country has been, and is, to produce a useful machine with absolutely no accomplishments. You all know him, a silent, awkward, self-conscious individual, whose thoughts lie too deep for words. Whatever culture he may possess has been acquired through association and reading in his later years.

So rare is it to find an instance of an engineer writing or speaking on any subject not directly connected with his profession, that an article by one of the members of the Engineer's Club not long since received an editorial comment in the Engineering News, because it was written by an engineer, and was not about engineering.

Engineers to-day are doing a great amount of research work, which is of tremendous value. Much of its real value is being lost, or perhaps, only postponed, because they do not place the results of their investigations clearly and concisely before the profession. It is apparently impossible for your true, dyed-in-the-wool investigator to reduce his language to the level of the ordinary designer or constructor of engineering work. There are a great many men who understand a subject perfectly but are unable to explain it in understandable language. This may be due to a careless habit of using words without due regard to the exact shades of difference in their meaning, or to hasty methods of reasoning, omitting several links in the chain of logic, on the assumption that the hearer or reader can fill up the gaps, or to drawing analogies where the similarity of cases is not at once apparent. So that it may, and does happen, that some results of engineering research gather dust on the shelves until some translator comes along and tells us what the investigator really dis-

covered. Or, perhaps, after long and diligent labor a student follows and captures a fugitive idea, reduces it to readable shape, and fondly believing it original with himself, proclaims it to the world. Then some fellow with a disgracefully long memory, recalls that some years ago So-and-so wrote something about that subject, digs up the original document from his dusty files, translates it and, presto! our student is covered with confusion and denounced as a plagiarist. All because the original investigator was unable to put his thoughts in understandable English.

Engineers have been accused of many deficiencies, for example, lack of business sense, of being impracticable, of being too utilitarian, of having no artistic sense, of being incapable of impartial judgment, of knowing nothing but figures, etc. These charges are often true, when applied to individuals in specific cases, but when an attempt is made to brand the profession, as a whole, with these broad and sweeping indictments, it should bring every engineer to his feet with an indignant protest. In general the engineer is your true man of affairs. His work and its associations compel him to master a great variety of things outside of those technical matters susceptible of being reduced to formulae. Not even the practice of law affords and demands a more thorough knowledge of human nature than engineering. The engineer cannot be a strict specialist, as can the physician for instance, who may know all there is to know about the human eye, yet be totally ignorant that there is such a thing as a corn or bunion on the foot, unless he happens to have one himself.

At least, the engineer cannot specialize to this extent here in the West, unless he wishes to experiment on how small an amount a man can live and not absolutely starve to death. If he wants to live comfortably and possess a larger income than a plasterer or a bricklayer, he must acquire and use knowledge on a multitude of subjects.

He ought to be able, if cast naked upon an unknown continent, inhabited only by ignorant savages, to set to work and so develop the natural resources of that country that in a few years there would spring up in that wilderness, cities with modern conveniences, linked together with the steel lines of transportation. There would be mills and mines, schools and churches, palaces and homes all over the land; civilization would replace barbarism and all this mighty change should come about, because our marooned engineer knew his business.

The engineer should be the foremost man in civilization today. He can be and will be, if we can bring the people to a proper appreciation of the important part he plays on this twentieth century stage.

In conclusion, I cannot do better than repeat the quotation made by President Swain of the American Society of Civil Engineers at Ottawa last June: "The fault, dear Brutus, lies not in our stars, but in ourselves, that we are underlings."

DISCUSSION.

MR. HUNTER. You have heard this most interesting and truthful paper, some parts of which hits a good many of us. The speaker, I am glad to say, was modest enough to include himself. There are some of our members, who are awaiting the opportunity to speak, and I will be glad to hear from them. Col. Ockerson, will you express yourself on this subject?

MR. OCKERSON. Mr. President, the subject has been so fully treated that there is little left to say about it. I, however, do not hold the pessimistic view of the future of the Engineering Profession that Mr. Wall has laid before us. I read a speech of Dr. Wiley's in which he says that if we will follow up the pure food propaganda we will have no disease—consequently we will need no doctors; having no disease we will have no crime, consequently we will have no lawyers; and, having no crime, we will need no preachers; consequently we will have the Engineering Profession safe for all time.

MR. HUNTER. Mr. Pitzman, have you anything to say on the status of the Engineer, as expressed by Mr. Wall?

MR. PITZMAN. I wish to say that I fully agree with Mr. Wall. I have been in Europe and I find a marked difference in Engineers in Europe as compared with Engineers in America, and I have always attributed it to the fact that the European Engineers receive a classical education in addition to their engineering education. Beside that, they don't have to look for positions. The Government takes care of them, advancing them from time to time and their whole experience is an education in itself, I think. They are looked up to as men of great prominence in Europe. Another condition is we are almost void of any artistic sense. You only have to go through the streets of any large city to see that. Look at our bridges. The bridges which we build are usually inappropriate for the locations at which they are built. When the Europeans build a railroad, if they have to cross

a river they detour the railroad a couple of miles to find a beautiful spot to cross the river where the scenic effect is developed. We do not do that here. Our hobby is to do everything as cheaply as we can and the result is the American Engineer does not occupy the position that the European Engineer does. Every Engineer employed by an American railroad is compelled to build everything as cheaply as possible. Every depot there is a handsome structure.

I do not see, however, how Mr. Wall is going to improve the position of the Engineer very much. I find amongst lawyers and doctors precisely the same condition as amongst the Engineers. I have a good deal of business in my office with lawyers, and I find that a great many lawyers come into my office who have great cases to defend, and they explain to me their cases and it takes me but a very short time to know that they know nothing about the cases which they handle. There is not more than one out of ten that will qualify to occupy a high position in his profession. Take the doctors. There is not more than one out of fifty that can make a correct diagnosis of a case. Take the surgeons, it is the same. Why should we pay such enormous fees to prominent surgeons? Why can't the others compete with them? Simply because they haven't the ability. Now consider the Board of Public Improvements of our city. I have always blamed the Board of Public Improvements for not being sufficiently progressive. They simply do the work which is given to them. They originate no work for the betterment of St. Louis—they wait for the City Council to direct them what to do, and I think in order to give the Engineer the position he is entitled to, they ought to be the originators of a scheme to develop St. Louis commercially and artistically.

Mr. Hunter. Mr. Rolfe, can we hear from you on this subject?

Mr. Rolfe. It struck me while Mr. Wall was talking that it was a good chance to work off a hobby of mine in regard to Engineering. While Mr. Pitzman was talking I made notes, starting in from this morning when I got down to the office, of the things that I took up as they came in during the day. I expect to have about a third of them down here, and as I finished my last note Mr. Pitzman made the remark that the Board of Public Improvements did that work that was handed to it. Well, that is true, and as an example of a portion of the duties of a Mu-

nicipal Engineer of to-day I would like to run hastily over these things that came into my experience this morning and draw a little lesson from them: I started in by climbing over the roof of the Court House to investigate some leaks. There were several Judges asking for a cleaning of their rooms, and while I was there I went over their quarters and looked up the question of cleaning the wall paper and cleaning the ceilings. I went back to the Hall and spoke to Mr. Moreno about certain sewers at the Infirmary that needed repairs. I went into the Water Department and arranged for some repairs to pipes at the Robert Koch Hospital at the Quarantine Station, and discussed with a boiler company the erection of a smoke stack at Quarantine. Then I looked after repairs to the tower clock at the City Hall. I called on the Comptroller and Supply Commissioner for a new automobile for the President of the Board, and arranged to "pull it off," too. Then a discussion of the strike of the steel workers on the City Jail came up. I received reports from the contractor on the construction of a bath house, kitchen and two sun porches at the jail now under construction, and steam fitting and boiler installation at the Workhouse, City Garage and City Hospital. I went over specifications and plans for porches for the Infirmary, and also plans for two large public comfort stations to be put under way. Also examined leaks in the roof at Union Market. The hobby I have had is that an Engineer is but an ordinary human being and subject to human fallibility in every way, and the more capable he is of forgetting the fact that he is a superlatively educated and highly trained man and getting down to ordinary every day humanities, the more certain he will succeed, not only as an Engineer but as a man. That, to my notion, should be the ultimate object of the training of an Engineer—not to make him a scientist; not to make him a professional man in the sense that the lawyer and the preacher and the doctor are professional men; but to make him an every day, ordinary man of common sense, with ability to meet emergencies as they come up, and so to push things along generally in the affairs of men. That is my idea of an Engineer—a man among men and doing his work as man to man.

Mr. Wall. Mr. President, will you allow me to say a word? In listening to Mr. Rolfe's long list of things that he could remember that he attended to-day, I noticed he left out one very important thing and that is he did not have a single caller asking

him for a job. Now in addition to the duties as one of the Commissioners and the work of the Board, every member of the Board of Public Improvements has to hold a levee every day in the week, if they can get in his office, of from one to three hours, on the job question. Now, Mr. Pitzman must have forgotten that every member of the Board has a Department that, in itself, is enough for a man to handle, besides taking care of the public in the way of artistic construction. If you advertise, as the law provides, that a certain street shall be opened, or a number of streets and alleys, or that they shall be paved, that community comes up to the City Hall in a body and you never get off on less than half a day. The whole Board has to sit and listen to the people on that street for a half day and, as Mr. Rolfe said, and repeating Mr. Pitzman's words with a different inflection, the Board does "what is handed to it."

Mr. Pitzman. I wish to say that I tried my utmost, as a member of the Commission on the last charter, to change the duties of the Board of Public Improvements. My desire is to have a Board of Consulting Engineers, and to remove the detail duty from them, because men for that position should be men who have had large experience and who have been in charge of large work, and the detail work can be done by men of inferior quality—favorable men selected by them—men who are fit to do one thing without covering the field. Men who are in charge of a large Department of the City of St. Louis should have knowledge of how other cities are conducted; how the work is carried on, how commerce is developed. My criticism of the Board of Public Improvements is that they must bother with the small details. I think the Engineers should take interest in the framing of this new charter so it will improve not only the field of the Engineers but also the position, because the American people will never esteem a man very highly unless they pay him a respectable salary. Mr. Wall, in his paper, referred to the heads of these Departments not assisting in raising the standard of the Engineers directly under them, particularly public utilities and municipal affairs, but you did not hear him make mention of the Board of Education.

Mr. Hunter. We have with us to-night Mr. Toensfeldt, who is with the Board of Education, and I would like to hear his views on the subject.

Mr. Toensfeldt. I do not know as I have much to say in regard to that. It occurred to me, however, that Mr. Wall's suggestion in regard to a clearing house of information concerning Engineers would be a good thing. Applied locally it would not be as effective as if applied nationally; at the same time it would help some. I think we would be in a position where if we were confronted with a vacancy in our Department we could find another one without scrambling around a while. I think it would be of assistance to find out all the available men in some city, and I suggest that if Mr. Wall considers it a good scheme he bring before the Club the question of appointing a Committee to work on the advisability of this.

[Note.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, by February 15, 1914, for publication in a subsequent number of the Journal.]

PROTECTIVE PAINTS AND PIGMENTS

By D. F. Leary.

[Read before the Technical Society of the Pacific Coast, October 30, 1913.]

The subject, protective paints and pigments, has roots going back to ancient times, but paint decoration in this country is comparatively modern.

For general painting there is one element, the salts of which Nature seems to have selected with especial care for protective coatings. These salts are peculiarly possessed of all the necessary qualities, for both wood and metal painting, in a superlative degree. This element is a metal, and like Truth it is weighty—with import. It is known as lead. I hope you will be patient with me whither lead may lead us. Among oil vehicles there is but one that gives general satisfaction,—and that is linseed oil.

A paint film should have opacity or covering power. Other things being equal, the paint with greatest opacity offers best protection. Thorough covering is also necessary for decorative effects; a streaked surface is not pleasant to the critical eye. Lead carbonate, white lead, ancient as Rome, is still the best covering white pigment for exterior work. It is also the best primer and undercoating for interior work. A paint coating, especially for metal, should possess the property of excluding water; it should be impervious to rain, fog and storm. The greatest foe of protective coatings, and surfaces protected, is moisture. Almost all paint films absorb it. Were it simply absorption of pure water the danger of destruction would not be imminent, but when it is known that water is a greedy absorbent of all manner of deleterious gases and acids pervading the atmosphere, then that paint film which bears strongest resistance to water offers the best and surest protection.

I turn to my tutor, Experience, and what does it answer?

"I have mixed water with all the best known pigments, opaque, transparent, crystalline, and amorphous; mineral and vegetable; and followed with an addition of oil, the result invariably being an emulsion, until lead pigments, white, red

and yellow, were reached, and these divorced themselves from the water to wed with linseed oil,—the water was thrown out."

I flew to my ready mixed paint samples to which I had added a small proportion of water, some time previous, and in every instance, other than lead, the water had gone down with the pigments. These pigments had greater affinity for water than for oil, although the water was added after the oil. In a pure white lead paint the water separated and remained in an uncombined state, the lead and oil apparently having been united for all eternity. This quality of non-miscibility with water; this remarkable property of combining with linseed oil in the presence of water, raises lead pigments above all others in the protective field and places them in a class by themselves.

Should the question be asked of any practical man, which white pigment works, flows, and covers best; dries best; and leaves the surface best for re-painting?—white lead should be the unvarying answer.

Were white lead universally used to the exclusion of other white pigments, there would be but little demand for paint burners and paint removers.

In the old days all carriage work was primed with white lead and raw linseed oil;—no dryer,—no turpentine. The iron work, being first sandpapered free of rust, was primed with the same mixture. I have never seen, by any sort of strain or twist, the priming lead coat divorced from brace, reach, fifth wheel or axle. I believe now, as then, that white lead and raw linseed oil, foot and water free, is the best primer for either wood or metal in this world. I believe it is the best primer for plastered walls as for wainscoting, and that no paint coating is safe to endure that is not based on a white lead and raw linseed oil primer, which is the eternal verity in paint protection. And (dare I say it?) in this is included paint for concrete, as I am convinced that there is nothing better being offered to date as first coating for concrete,— preceding the lead, if you will, with the usual zinc sulphate, or other calcium neutralizing, bath. Notwithstanding all the failings attributed to white lead, one could not find a ready-

mixed paint, apart from the solid colors, that does not contain a large proportion of it. All promoters of by-products had to come to this. You know that any one who has any leavings or dirt of any kind in manufactures, or of earth on his farm, or worthless tailing at his mine, wants to introduce it as a paint pigment: as the best protector "ever" for metal. All these rock and earth rooters, with their panaceas for the ills of protective paints, to sustain their *"matter"* at all in place are forced to reinforce with white lead, the pigment which they are loudest to abuse. Is not this another grand tribute to the virtues of the best of pigments?

It is almost impossible to conceive any situation where a covering coat is required that does not clamor for white lead —and demand it in large proportion.

White lead has but one competitor, zinc oxide. There is also a new white under various names, the best known of which is Ponolith, but this is truly a competitor of zinc for interior work; it has failed totally for outside protection, and like many other lead competitors is now classed as a rust stimulant. Zinc oxide loses by comparison with white lead; it does not cover as well; nor work or flow as well under the brush,—being fluffy and unpleasant of application; it does not spread as evenly or leave the surface as smooth or as free from brush marks.

Zinc white is a slower dryer than white lead, and in drying, the pellicle assumes the coloring principle peculiar to the manganese drying-salts common to liquid dryers, which it fails to yield up; while white lead bleaches the oil and dryer with which it may be combined.

Zinc white also reacts on linseed oil to form a zinc oleate, but ordinarily in paint it has greater affinity for water than it has for oil. To this failing is due in great part the rapid hardening, cracking, and peeling, peculiar to a pure zinc oxide paint. Such failings are not conducive to protection of either wood or metal. The weaknesses of zinc as a basic paint are now so manifest to all engaged in the paint industry that its most ardent defender would not dare to advocate it.

Zinc oxide makes a good water paint; it also makes a good enamel—the best; but the basic structure should be white

lead, and even the drying, working and elasticity of the last or enamel coating is often improved by a proportion of white lead. Zinc white is also accepted and applied in varying proportions by painters, according to temperament, as a corrigent to the chalking which a pure white lead paint yields to time.

Yes, the white lead paint has chalked some, but where is the pure zinc paint that was applied on the same date? Ask of the winds! Around on the other side you may find a few cracked patches, that did not peel, with the wood showing through; if it be metal, some streaks of rust where the zinc had been; some peelings, shreds, that speak ill of the glory, all departed.

It is useless to repaint over zinc that has cracked because the sun will bring out all the old cracks through the new paint as on the repainted carriage, or auto body, from which the cracked coating was not removed. There is no evading this law. It is admitted, it never has been denied by practical men, that white lead leaves a better surface for repainting than any other pigment. One would think this alone should be sufficient cause for exclusion of all other paints and pigments from the field, in exterior painting. All things must be renewed. No paint wears forever. Then why in the name of heaven do men not use that which is easiest and cheapest of renewal? Will man never learn to place his finger on a truth and keep it? Must every advertisement of every new nostrum forever keep leading men astray?

Some years ago, while engaged in investigating the best methods of grinding color pastes, including whites, the idea of grinding oil pastes in water to prevent the formation of skins was tried out. Zinc oxide paste proved to be the most readily absorbent. It became, under the water, hard as cement, and in the hardening, the bulk and shape had changed sufficiently to crack and tear the surface. How was it with white lead? There was no absorption, no hardening, no change. The oil lead paste took no cognizance of the presence of water; the lead pigment and oil were newlywed and devoted in their union, to the exclusion of all things else.

Of course, we all know that white lead is now mixed, almost universally, with oil in the presence of water. In a large

mixer holding many tons is white lead pulp that has been ground, washed and prepared with machinery that seems to have a soul, so accurate, is its performance. Into this tank, the contents of which are in motion, linseed oil, from a gauged container, is run, and in a short period every particle of lead is seized by this oil, and in combination they go to the bottom, the clear water on top. The lead oil paste drops into other mixers to be deprived of clinging or interstitial moisture, ere falling to the mills from which it is ground into the packages of commerce. Let us not forget that all pigments, other than lead, will not yield up water in favor of linseed oil, and that they absorb water, even after they are ground in oil, and white lead's superiority in the presence of moisture will go unquestioned.

The first time I witnessed white lead in the process of manufacture my mind was filled with wonder and reverence for the laws by which a dull metal was changed to beautiful white pigment. Lead metal, or pig lead, is fused and molded into buckles that fit in pots in which is a diluted form of acetic acid. These are placed in stacks covered with boards on which tanbark is piled. By the heat, arising from the fermenting tanbark, the evaporation of the acid is hastened; simultaneously carbon dioxide, a product of fermentation, is forming, and these agents, following beautiful laws, work silently in the darkness for three months, manufacturing white lead. It was midway in this process that a plank was removed from the top layer of pots, for my benefit, in which I had seen the dull lead buckles placed six weeks previous,—and what a transformation!

There in that moistened tanbark with its tannic acid and other excitants was fermentation set up with its concomitant heat and carbon dioxide product, which with the vapors of acetic acid suffused the carefully measured atmospheric air of the chambers. These mingling agents cause oxidation of the lead metal, protoxide being formed; this protoxide forms the base of a neutral acetate which taking up a further equivalent of protoxide, forms the subacetate of the metal; this in turn combines with carbonic acid exchanging its neutral acetate to form lead carbonate, white lead, which neutral acetate

again seizes on another portion of protoxide, thence as before combining to form subacetate and in turn taking up carbon dioxide. 'Tis thus by moving electrons, from atoms to molecules, until the entire metal is changed to the pigment known as the carbonate of the protoxide of lead.

We have, owing to genius and patience and care, after many years of study, succeeded in producing very good ready mixed paints. We have developed a method or treatment of linseed oil that in combination with an alloy, if I may so use the word, of lead and zinc, makes just as good a film as a lead paint. The special treatment of the linseed oil makes up for the deficiency of the zinc in combining power in elasticity, and in water resistance.

White lead is not reinforced by zinc in ready mixed paints; the reverse is true. Were pure zinc paints desirable and effective in paint protection, white lead would not be added. But it remained for a manufacturer of white lead on this Coast by special oil treatment to produce the best combination of lead and zinc as a mixed paint.

White lead sole would not answer as a ready mixed paint; it would not keep in an acceptable condition. Lead salts possess the splendid attribute of yielding to linseed oil the varnish quality. The excess of pigment required in a covering paint over that quantity used for varnish dryers would be too violent, carrying the varnish quality too far, and the oil would become fatty beyond even a varnish consistency, and eventually the pigment, owing to changes in its hydrated content, would lose its covering power, and this is why there are no pure white lead ready mixed paints on the market.

It is this varnish making quality that lends to the linseed oil film greater elasticity with less voids, and consequently it is more impervious than is the film of linseed oil with any other pigment. Surely white lead is nature's first choice for protection.

Now promoters and advocates of lead substitutes, which they are forced to admit, are rust stimulants, while telling us that the film of linseed oil is porous and subject to hydrolysis and therefore offers poor protection for metal, recommend that if, when using their wares, we add some gum or varnish tc

the paint, the voids in the linseed oil film will be filled and protection assured. Here is a further invitation to inevitable ruin.

The merest tyro in paint and varnish manufacture knows that even the best gum, though it may add to the body of an oil, can have in the finale but one effect: it will cause checking. For thirty years I have been investigating varnishes, their use and manufacture. During this period of investigation I discovered one unvarying law that was impossible to escape. The farther I roamed by additions of gum from the pure prepared varnish oils, the quicker did the elements of decay enter the surface, and, tracing backward from any side, or by any road, and with any choice of gum, the closer I came to the pure oil the greater the durability; and that through the smallest proportion of gum added would set in the processes of decay long before the pure oil had furnished signs of surrender to the elements. This sort of decay is accelerated, of course, by the presence of a pigment in addition to the gum.

White lead and linseed oil form their own void filler. They hold few open doors to moisture,—the mother of rust. They prepare their own medicine. They have the strongest grip on wood and metal of any paint known to man. United they will not emulsify with water, but will, when mixed with gum or rosin varnish; so that the gum addition instead of offering a cure, promotes contagion.

The best imported and home-made enamels are now being made with beautifully prepared varnish oils altogether free from gum, and why? Because the makers have discovered they are more durable without gum.

There are situations perhaps when white lead may with benefit have a proportion of zinc oxide added to the final coat. At least it has been so claimed by painters whom I know to be honest men. If the proportion is not large enough to harden and impair the elasticity of the paint there is no objection, but such doubtful reinforcement I claim under any circumstances could only be necessary in the final coat. Did all painters possess the treated oil used in the ready mixed paint referred to, zinc could be safely added, but that oil is not on the market.

White lead is the only true and safe base for paint protection. As a primer for metal I personally prefer it to red lead. I do not say, however, that it is the most profitable to use. Time as an element in this rapid moving world enters here and is a determining factor. Popular demand favors red lead, and I must yield. I can do so gracefully because red lead does splendid work in metal protection, better than anything offered and tried as a substitute. However, if I cannot have white lead as a first coater, permit me to offer it as the first succeeding coat following the red lead, before the final tint or color coat is applied. This is on the principle of a beautiful, flowing, elastic and durable varnish applied over a flat, quick-drying, ground color on a coach or automobile body.

Red lead in its application has to be used in excess to "stand up" on vertical surfaces: it is more rapid, more violent in its action on oil than white lead, which fact, together with the danger of excess of pigment, may result in a coating too short in oil for elasticity and durability. The film is waterproof and rust inhibitive, but it is less elastic than the white lead film; and this is the reason why I would saturate its surface with its kindred salt combined with a larger proportion of oil,—a coat more elastic, as strongly inhibitive of rust and fully as resistant to moisture. In this way perfect protection for metal surfaces could be obtained.

White lead and raw linseed oil, free from foots and moisture, spread on thin,—the surface being dry and free from rust,—let us say on the morning of a pleasant day, at an hour when the fogs and dews have vanished; and then, proper time being given to dry, a second coat to be certain that the surface is properly covered and this thoroughly protected with color coats, as desired. the surface will remain sound long after red lead has begun to fail.

Red lead dries quicker; it makes a heavier coating; and, when properly mixed—(that is when there is not more than can become thoroughly saturated with the oil),—one coat perhaps would offer better protection than would a single coat of white lead. It certainly affords far better protection than any other pigment. It seems to me that a good rule in red lead painting is to add just enough red lead to the oil to hold without breaking on the surface. Red lead is now prepared so pure and so fine that there is little difficulty found in its application. But were

I an architect or an engineer, and discovered red lead contained over 85 per cent red lead, I should add to it a percentage of litharge. I want my good old fashioned red lead that will harden. I want it to act on the glycerides of the oil to produce rapidly the lead linoleate cement underwear that Almighty God in his wisdom intended for metal protection. The very pure red lead, 95 per cent red lead, is specified by the Government. I doubt the wisdom of those specifications. A much larger percentage of protoxide is necessary to secure the best possible results. Since this paper was prepared I noted with pleasure a red lead specification of Mr. Gardiner's, calling for 18 per cent litharge, which proves that one writer has arrived at the true philosophy regarding red lead protection. This gentleman has found, as all may find who search diligently, that a combination of the lead oxides is far superior to all other pigments in metal protection; that like the carbonate it is in a class by itself as an eternal verity for which there can be no substitute.

Some years ago a cloud loomed black above the horizon; it contained graphite, and so well was it guided that it threatened to deluge with its content every paint factory on the face of the globe. Mexican graphite, so fine it fell upon us! The powers of Niagara were utilized and electric furnaces installed to manufacture this grey diamond! Gold miners turned from their quartz and placer caches to search for graphite! Wells-Fargo's business had reached a convulsed stage due to shipments of graphite samples; the mails each day contributed a full quota. How lucky for us that there was in those graphite days no Parcel Post!

Oh, those graphite promoters! The tales they told! "Graphite covered well; graphite being inert had no action on linseed oil; it was acid and alkali proof; it had a greasy nature repellant to moisture." Among pigments, graphite was the duck that gave to water the quality of quicksilver! It quacked loudest of the brood of substitutes offered then and since.

Carbon, from a gas source, could not equal its elder sister in wind. Barium and Calcium sulphates, Aluminum and Magnesium silicates! These inert pigments so precious of linseed oil, they wouldn't, couldn't, injure it as red and white leads do. These acid and alkali-proof, water-shedding, insoluble crystals, how tiresome they had grown, what a menace they became, what evil they had done before being found out. How long and tedious

the trial which finally placed them where they belong—in the class of rust stimulants! Graphite shines no more as a metal primer.

Carbon black! The gaseous emanations of its claquers threw its baleful cloud for a time over iron that through consequent rust made a red appeal for a return to lead protection. These gentlemen did not know that the qualities attributed, which they decreed as failings of lead pigments, are just what is necessary to a protective paint film, and that no form of inert crystal, especially those known to be good conductors of electricity, could possibly compete successfully.

Mechanically, amorphous pigments pack closest; crystals leave room for interstitial moisture. Crystals, while they may not be absorbent, leave open doors in the paint film, so that in addition to the breathing pores, attributed to linseed oil, these inert crystalline pigments weaken it still further with their thousand mouths, or apertures, inviting moisture. Crystalline coatings are victims of hydrolysis, and decay soon asserts its deadly sway. Furthermore, these substitutes, individually or in combination, being good conductors of electricity, cause destruction by electrolytic action and consequent rust and decay. They are proven stimulators. As priming coats for metal surfaces, they are abhorrent, and, were a metal a thing of life, it would shrink appalled from the contact. Must we use such coatings at all, let it be always on a lead base. Assertions oft repeated make converts in the paint protective field; all promoters know this and take advantage of it, but this does not make protective that which is not. The trouble in the paint business is that it takes a long time to nail a lie and much damage is done before the true protective paints become again triumphant. In the very nature of things there can be no substitute for lead pigments in protective painting of wood and metal.

Let us here by the lamp of reason apply the magnifying glass of the mind to the surface of a paint made with an inert pigment. Such a mixture can only be mechanical; there is no actual combination of oil and pigment; little granules of pigment are simply packed in linseed oil. Now then, let us abrade the surface of such a film and we will expose unsaturated, uncombined pigment; that is absorbent of moisture; from this conclusion there can be no escape. On the other hand, lead pigments combine chemically with oil to form lead linoleate. The abrasion of

a lead linseed oil film, it is plain, can present no unsaturated pigment; it is right through resistant to moisture and the union has but strengthened the Linseed Oil by filling up the voids peculiar to it. Thus, it is seen that from any viewpoint lead pigments present superior qualities for protection.

Dr. Dudley, the one time chemist of a Pennsylvania Railroad, who wrote so fluently on protective paints, was the high priest of advocates of iron oxides and their derivatives. All Dudley deemed necessary to produce a better protective coating than lead, was an addition of calcium sulphate, gypsum, to iron oxide. He did not claim that the oxide redeemed the sulphate, but that the sulphate saved the oxide from dissolution and an early death. The weakness of this theory becomes obvious when we learn that sulphate of lime is soluble in water 1 to 400. And I want to say right here, that I would not use a sulphate of any kind, no matter how staple the salt, for paint protection. The sulphates are not staple; they yield up acid to some paint menstruums, more particularly to turpentine. Some time ago an effort was made to produce a paler paint dryer than any on the market. The sulphate salts of most of the active minerals used for dryers are white, or colorless, so we turned to these. Using about 10 per cent with another mineral salt, lead, the results were gratifying as to color and siccative property. This last quality was sufficiently pronounced to allow of paling the color still more by further addition of solvent till the strength was reduced to that of its strongest competitor. The completed dryer was not only not acid; it was slightly alkaline. Adding the turpentine, the graduate was set aside that it might clear In the fullness of time we turned to it and behold! the dryer was almost black; the glass was hot enough to burn the fingers; a trial of litmus proved the contents to be strongly acid;—the sulphate had been decomposed, yielding free sulphuric acid to the turpentine. I concluded sulphates with turpentine might make terebine, in pharmacy a good medicine for coughs or other pectoral complaints, but as for dryers or paint pigments others could use them, I would hesitate.

This Dudley diversion from lead paints; this iron oxide, sulphate of lime, theory of protection; this curing of rust by the addition of rust, or a close approximate with the same base combined with a soluble sulphate, must have cost the railroad companies of the country and the public generally untold thou-

sands. Peace to his ashes! He was, doubtless, honest, but the faith in his theory has perished.

Lead sulphate is being loudly lauded by some late doctors who hold degrees from the colleges of self-conceit or self-interest. All the other soggy planks, having failed them they now cling to this. There is but one good thing about this salt: it has a lead base; but it is degraded and corrupted by evil association. I cannot imagine any paint mixture that could be but injured by the presence of lead sulphate. As I said before, there is grave danger in the use of any pigment combining sulphuric acid with a base. Its use is an invitation to gray ruin. Lead pigments, the oxide and carbonate, cannot be displaced. In the line of paint protection there is none other so filled with true promise and performance.

Recent promoters of chromium products have put forward the idea that cromium salts are most inhibitive of metal corrosion, and cousins by law, or by marriage, or private contract. But this theory died a-borning. The chromates failed in practice on the face of metal; they proved to be good producers of rust, and soon with the other agencies of destruction, these moisture ushers were neglected.

God in his infinite wisdom alone knows the nature of the next fake that is to be exploited in the paint field. It is a generation since Dudley passed, and the promoters of iron oxide pigments, in their efforts to secure his writings, must feel hopeful. There are gullible souls living in the present generation who will hail any nostrum new to them. Let us hope that architects, engineers and master painters are progressive in that they have become wiser, and will hold fast to that which is good. The sun is old, but, in little matters of life, light, and heat, it is still indispensable. So it is in the paint world; protection is life to metal and wood,—and lead pigments offer the safest protection.

To show the affinity lead and linseed oil have for each other, I will cite an excellent illustration. Once while in charge of a Color Works, I instructed an assistant to make a small mixing of dry white lead and linseed oil. It was then almost quitting time, and, instead of mixing them together as directed, he poured the oil into the mill hopper and dumped the white lead pigment therein, then quickly covered the hopper. Next morning, upon uncovering it, he found the crude unmixed mass on fire. Here was the doctrine of affinities exemplified in an extraordinary de-

gree; here was shown fierce passion between linseed oil and lead that was satisfied only by complete saturation. Give me first, last and all the time, the product of such a union for stalwart protection.

In the field of dryers what have we? Lead salts again the best. Is there anything in God's providence more wonderful than this? A dull metal providing us with the best working and flowing paint; the most elastic film, and the most durable; offering the best protection for wood and metal; linseed oil's magnet and affinity; abhorrent of moisture with its corrosive gases in solution; the most powerful chemical base; and, to add to all,—to crown it as the King in oil painting,—the best, most elastic, and most durable oil dryers,—the dryers that yield the varnish quality; the dryers that, while carrying oxygen, are not electrolytic like others such as manganese. And these, like the pigments referred to, requiring for reinforcement lead salts in large proportion.

Lead first, last and all the time was the true choice of Gods and men. There is in lead everything needed in a paint or paint-base that requires but a little coloring matter to tint it for decorative purposes, and which usually redeems it of the only failing attributed to it, or that is at all susceptible of proof. There is rarely any sign of chalking on lead tints.

Now I have discussed the basic paints, if not in an exhaustive manner, at least in a manner that probably has exhausted my audience. In treating of the bases we cover the entire ground, for then does the painter and decorator enter to add his tinting colors. These are now prepared in paste form, in San Francisco, from the best pigments the world affords, and ground to the finest degree by the most modern machinery. Here can enter no poor pigment. Nothing defective can possibly escape our argus-eyed color detectives and their methods. From the world markets are gathered at New York for comparison, samples of every kind, submitted to color experts and thence shipped to San Francisco for comparison with other portions of the same high standard as held at New York. Samples of the shipment, on arrival at New York, are also compared. These are forwarded to San Francisco to be again tested with the standard and also with the contents of the packages on arrival, and by such care in selection the best is always secured.

On any scheme of decoration I will not dwell. Your senses along these lines are fully developed. You could, doubtless, along the chromatic scale, give points to Chevreul on contrasts, complimentary colors, harmony and all the blooming jugglery of tints, color schemes and chiaroscuro that intensify the grace and beauty of your ornate designs.

The great world of men, the laity, have not the slightest conception of what the world owes to the architect for setting the fashion of color schemes for office, store, hall, church and dwelling. So few are aware of the effect that color has upon their sensibilities, their emotions. Even you do not, perhaps, realize how far reaching is your work, in the psychic domain of human minds, in fostering repose, peace, and uplift, by intelligent selection in color schemes.

In tinting, or solid color painting, mineral pigments as a rule are more permanent than organic. The most stable pigments, those chosen by long usage, are the most important. We have blacks that lived in the tusks of monsters in African Jungles, perhaps slain by Teddy; blacks from "the vine clad hills of Bingen, fair Bingen on the Rhine;" umbers from Cyprus in the Levant, the sea charm and mysticism; siennas, raw, from Tiberian mines; siennas burnt in the shadow of the coliseum. We carry oxides from Derby of Royal patronage and equine speed; blue ferrocyanides, chromes, green and yellow, from the Hub of the world, the product of the best culture in the color field; ultramarines, rich, cool, and soothing as distillations from the slopes of Parnassus; and carbon from the throat of the world; all ground to a degree of comminution equaled only by the mills of the Gods. We appropriate all the analine beauties of German research to color the most beautiful lacquers that greet the senses; blues shimmering in a diaphanous web of fairy iridescence; greens like the glintings of opals, the distillation of emeralds from enchanted alembics; yellows with the sunlight chastening through, like Dawn's first greeting to the world; transparent gold convulsed with flush of rubies; oranges like phantom lakes hemmed in peacock hues, peculiar to tropic skies; reds like the linings of rose and geranium; reds, gorgeous glowings of ruby and crimson; reds, rich in vermilion splendor and glorious as the sunset, ere the blinds are drawn by the blue fingers of the night; purples richer than those lost with Tyre, from the faintest lavender to the royal color of Kings.

[Note.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, by February 15, 1914, for publication in a subsequent number of the Journal.]

THE TESTING OF COAL FOR PURCHASE.

By J. M. Goldman, M. E.. U. S. Inspector.

[Read before the Engineers' Club of St. Louis, April 30, 1913.]

The subject matter of this paper will deal only with Illinois bituminous coals purchased for steaming purposes by the U. S. Engineer Office at St. Louis, and by local power producing corporations; it includes a resume of geological conditions of the deposits, the heating value of the various coals, sampling in the mines, deliveries to consumers, the preparation of samples, the laboratory scheme of testing, the fundamental characteristics of the coals with respect to purchase, and a method of comparing grades of coal by formula on the basis of heat units contained.

The recognized number of coal seams in the Illinois field is sixteen, but those commercially available are only five, namely—No. 1, No. 2, No. 5, No. 6, and No. 7, and have been classified as follows:

Seam No. 1, underlying the counties of Rock Island, Mercer, Warren, McDonough, Fulton, Schuyler, Brown, Scott, Green, Calhoun, Henry, Jersey, Hancock and Christian. Tests from various mines in this seam show fair grade of coal containing 10 to 15 per cent moisture, 5 per cent sulphur, 8 to 10 per cent ash, and 11,000 B. t. u. per lb. dry. This seam under normal conditions of mining is fairly clean and free from impurities.

Seam No. 2 underlies the counties of Bureau, La Salle, Grundy, Will, Putnam, Stark, Marshall and Woodford. Analyses show good steaming coal, containing about 15 per cent moisture, 2.8 per cent sulphur, 7.5 per cent ash, and 11,400 B. t. u. per lb. dry. This seam is slightly better than No. 1, having less sulphur which occurs in coal in thin sheets of marcusite and pyrites, but the mine-run product is apt to contain a higher ash content as the seam lies in two beds separated by shale partings ranging in thickness from 15 inches to 20 feet.

Seam No. 5, is found in two districts, known as Central and Southern. The Central district comprises Peoria, Fulton, Tazewell, Logan, Menard, Sangamon, and Macon counties, and the Southern district comprises Saline and Gallatin counties. Tests of coal from these mines show a content of 15 per cent moisture,

3.5 per cent sulphur and 10,500 B. t. u. per lb dry. This is the poorest steaming coal in the field, as the seam is cut by numerous vertical clay veins, varying from a few inches to four feet in thickness, and, in addition, contains pyrites or "sulphur balls," and is capped by limestone, which if not cleaned from coal after it is shot from place in the mine, causes pasty fusion of ash, and consequent clogging of air passages in grate bars.

Seam No. 6, west of the Du Quoin anticline, underlies the counties of Jefferson, Perry, Jackson, Franklin and Williamson counties, and east of the anticline in Sangamon, Christian, Moultrie, Shelby, Macoupin, Montgomery, Madison, Bond, St. Clair, Clinton, Marion, Washington, Perry, Randolph and Henry. The analyses of this seam show inconsistent heat values, ranging in places from good grades of steaming coal to very poor. An average number of samples tested show grade containing 10 to 11 per cent moisture, 3.5 to 5.5 per cent sulphur, 13.5 to 22 per cent ash, and from 9,000 to 10,500 B. t. u. per lb dry, for mine-run product. This seam is commonly known as the "Blue Band Seam" owing to a blue clay or shale parting 20 inches above the floor of the mines. In addition, the seam has limestone for cap rock, and there occurs in it sulphur balls occasionally 6 inches in diameter. In places, this seam is so persistent in slate bands and sulphur impurities, that it cannot be mined economically. This seam furnishes much of the coal to St. Louis and vicinity, with some coal from the southern counties, the Big Muddy and Carterville districts.

No. 7 Seam underlies Vermillion and Edgar counties principally, with Danville as a center. The tests on this seam show grade averaging 14 per cent moisture, 2 to 3 per cent sulphur, 9 to 10 per cent ash and 11,200 B. t. u. per lb dry. The seam is thin, and the coal is poor and has no market outside of the counties of its production.

From the foregoing paragraphs it is seen that coal in the market may vary greatly in value as a fuel, and in order to determine intelligently the value for any particular coal, sampling and testing are necessary to determine approximately the contents of the constituents favorable or unfavorable to the proper and scientific combustion of the coal under the steam boilers.

Inability to obtain representative samples of run of mine coal at, or in the mines, has been the cause of much friction over contract specifications, and the over-rating of the steaming value

of coal by bidders to consumers. The coal operators depend wholly on the reports of the different surveys for the assays of the face workings of the mines. These are taken in the following manner:

An oil cloth is spread on the mine floor immediately at the base of the seam, and a strip of coal 4 to 6 inches in width is picked down the entire length of face to a depth of 6 inches, having carefully avoided, on a first operation, weathered coal. In the process of cutting down from top to bottom, any bands of slate or shale, sulphur balls, and other impurities which exceed in thickness one-half inch, are thrown out. The complete sample thus secured represents fairly, and in a general way, the average material which is accumulated from actual mining condition. But from the description of the seams, and the method of sampling, it will be evident that in reality the sample thus obtained must differ in certain particulars from the coal as mined and made ready for market. In this method of sampling there is lacking an agreement or rule governing the amount of "extraneous" matter, such as partings, slate or shale, "limey" roofs or dirt, all of which effect the grade of coal, and in consequence of the method and manner of mining, these impurities enter into and vary the samples of run of mine coal. Therefore, it is extremely pertinent to both buyers and sellers that the samples taken should accurately represent the values of run of mine coal under local mining conditions, and should not be picked samples from coal in any place in the mine.

Of equal importance to securing by the mine operator a representative sample of the coal to be sold, is the sampling of coal upon delivery. Many schemes of sampling by shovel, and use of mechanical samples have been proposed for bulk deliveries on board cars, steamboats and barges. The following system is used locally by the U. S. Engineer Office for sampling its coal upon receipt in bulk or barges, or on cars or on board steamboats. Separate samples are taken from each delivery and are forwarded in waterproof bags by Parcel Post to the U. S. Testing Laboratory maintained locally at the U. S. Engineer Depot.

The samples must be taken before wetting down the coal and in the following manner: Pipes about 3 inches in diameter by 6 feet in length are driven in opposite sides of each car load or pile of coal on the cars, flatboats or barges, and the cores so obtained are collected, in gross, in a common dry receptacle. If the

coal on the barges is not in piles, but spread on deck in a depth less than 5 feet thick, or carried in open barges, the samples must be taken at intervals not greater than 20 feet on each side and not more than 5 feet from the edge of the load. Coal in cars must be sampled by driving the pipes in three places not less than 10 feet apart. During the process of sampling, picking out of slate, sulphur balls, or other impurities, or in any manner selecting special coal is strictly prohibited.

After collection, the gross sample is emptied on an iron surface, clean, dry, and free from rust, and the coal is crushed to pass through a ¾-inch ring. After crushing, the coal is spread evenly over the iron, and by shoveling gradually from edge to center, formed into a conical pile, the top of which is leveled off and the coal again spread over one-half the space formerly occupied, divided by quartering to about 10-lb. lots, one of which is selected for testing.

It is the aim in all sampling and quartering to eliminate as much as possible the personal equation. Consequently, in arriving at a method for sampling in gross, pipe sampling seems nearest to the elimination of this factor over any other method yet devised; and although this method is not perfect, nothing better has yet been offered.

In addition to the method of pipe sampling described, the U. S. Bureau of Mines has developed the "long" pile and "alternate shovel" method by which the coal is sampled at time of the unloading from railroad cars, ships, barges or wagons, by a shovel or specially designed tool, which is used for taking portions or increments from 10 to 30 pounds, or from slack or screenings 5 to 10 pound samples.

If desired, the coal contractor may be present or represented to see that the increments are regularly, and systematically collected, and that the entire delivery will be fairly indicated in the gross sample of not less than 1000 pounds will be collected. If the coal contains an unusual amount of impurities, and if the lumps are very large it may be necessary to collect larger gross samples, say 1500 lb. or more. For slack, screenings, etc., where impurities are fairly homogeneously mixed throughout the mass, a 600 lb. gross sample is recommended.

Samples smaller than 250 pounds are mixed on an 8 ft. by 8 ft. canvas, by raising first one end and then the other, thereby rolling the sample back and forth. Some criticism has been

made against the Bureau of Mines' method owing to low market prices of coal, as the sampling methods are taken from treatises on ore sampling where the crushed ore to be mixed and quartered is usually worth many times more than the coal. In reducing the 1500 lb. gross sample to the 10 lb. laboratory sample, it undergoes ten operations of mixing, crushing and quartering before reaching the laboratory. The time thus consumed is about two days' labor at $1.80 per day, and the cost of sampling, alone, is about 6.5 cents per ton. Many private laboratories in this section of the country test coal for 1¾ to 2½ cents per ton, based on large unit deliveries.

In all testing it is of utmost importance that the small portion taken from analysis shall accurately represent the average composition of the shipment. This is especially true for coal in which sulphur and ash are irregularly distributed. Also the amount of moisture in the coal and in the sample vary from day to day, depending on the humidity of the air in the mine, exposure to sunshine or rain in transit, etc., and for this reason a sample of coal may have a different composition on arrival at destination from that possessed when mined. But the results of all tests from any samples of the same coal should agree if the sampling has been done under same conditions; and the results calculated to a dry basis. The coal samples on arrival at the testing laboratory are usually crushed to particles about the size of a pea, or so as to pass a No. 6 sieve.

After exposure to the air in the laboratory for an hour at about 70° F., the sample is crushed to pass a 40 mesh sieve, well mixed, and quartered. One quarter is reserved, ground to pass a 100 mesh sieve, and put in tightly stoppered bottles, from which gram portions are taken for the laboratory tests.

For determination of moisture, one gram of the general sample is weighed in a platinum crucible, dried by heating for one hour to and at 212° F. The crucible is then cooled in a dessicator and weighed. The difference in weight is the amount of moisture. Although seemingly a simple operation, the determination of moisture, if not carried through with great care and precision will, in converting coal from wet to dry basis, alter the result about 100 B. t. u. for each 1 per cent of error. No special moisture sample is taken in this proximate method of analysis, and the moisture in the finely ground sample is determined solely in order to calculate coal from wet to dry basis.

From the great number of samples which have been taken in the Illinois mines, it can be safely said that these coals average 10 to 15 per cent moisture at the mine where the shipments originate, and lose 5 to 10 per cent en route to destination. Moreover, the U. S. Engineer Office at St. Louis buys all coal f. o. b. place of consumption, and therefore pays no freight on the water contained in the coal.

In speaking of "wet" coal and "dry" coal, it is evident that these terms are generally not clearly understood. These terms have a specific meaning in engineering parlance. "Wet" coal defines the actual condition of coal as received and sampled before test. "Dry" coal is a calculated result obtained by subtracting from 100 per cent the amount of moisture from the calorimeter sample and dividing the remainder into the B. t. u. contained in the coal "as received." The "dry" coal basis therefore establishes the base grade of the fuel, standardizes, and eliminates all variables due to moisture.

In the determination of the amount of volatile matter, the residue after the moisture test or, if preferred, a new test sample from which the moisture has been expelled, is placed in a 20-gram platinum crucible having a well fitted cover to prevent the escape of solid particles, and heated over the full flame of a standard Bunsen burner for seven minutes. The loss in weight is the content of volatile matter. The bottom of the crucible should be 25 cm. above the top of the burner, the flame should be about 10 to 15 cm. long, and the determination made in a room free from draughts.

Such determinations of volatile matter, however, are open to criticism as there are possibilities of oxidation of the contents, with too great a heat, incomplete combustion, or other variances caused by the quality of flame, and shape of crucible. The probable limit of variation in tests above is 1 to 5 per cent.

Sulphur determinations are made from bomb residues of Parr calorimeters in an especially designed sulphur photometer. The specific amount of sulphur in coal is needed in computation of the B. t. u. as will be explained in the paragraph on the heat calculation. The sulphur is also accounted for, partly, in the volatile matter and in the ash, and a determination is made especially for the total amount contained in the coal.

The fixed carbon represents the difference obtained by subtracting the determined percentage of moisture, volatile matter,

and ash, from 100 per cent. After the other constituents of the coal have been combusted, there remains the ash, the negative index of the value of the coal.

In the ash determination, the coal is placed in a platinum crucible and burned to black slag in the presence of oxygen supplied from a low pressure tube. This method reduces the sample to ash in about five minutes, minimizing errors and standardizing the results. Other methods of burning the sample, for example, by placing over a Bunsen burner for three to four hours gives 1½ to 2 per cent more ash than when using oxygen. In justice to coal operators, the oxygen ash determination, as it approaches more closely the furnace reduction of the fuel, should be made standard and specified in all coal contracts.

Determination of the B. t. u. is made by use of an instrument called a calorimeter, of which there are many types in use. The Bureau of Mines and many municipal laboratories use the oxygen bomb type, as a greater range of precision has been attained with this type of machine than with any other. The Parr calorimeter has given satisfaction, as its commercial range of accuracy on the same sample is well within reasonable limits, and it can be installed and operated more economically than the oxygen bomb type.

In manipulating the Parr calorimeter, the directions furnished with the instrument are followed exactly, and, briefly are as follows: A 0.5 gram sample, moisture free, is mixed with one 30-gram measure of sodium peroxide, and one gram of an accelerator, and the whole charged in the steel bomb. The bomb is placed in a can containing exactly two litres of water and revolved until the water has reached a constant temperature. The charge is then fired by electric fuse, and the bomb revolved in the can for 3 minutes, after which the thermometer readings are taken and the maximum rise in temperature noted. The temperature results so obtained are used in a formula by which the B. t. u. per pound of coal are calculated as follows:

1. Reaction in bomb after firing=
   73 per cent of heat due to *combustion of coal*
   27 per cent of heat due to reaction of CO_2 and H_2O in contact with $Na_2\ O_2$.
2. Weight of water in can = 2000 grams
   Weight of bomb complete = 135 " equivalent to specific heat of metal.
   System sensitive to heat 2135 "

3. $\dfrac{.73 \times 2135}{.5 \text{ (grams sample)}} \times r\ (F^\circ) =$ B. t. u. per pound of coal

$r =$ corrected rise (F°).
$v =$ initial reading.
$p =$ maximum rise from a constant temperature sustained 3 minutes after firing (usually 3° to 4° F.)
$v - p = r.$

4. From r (F°), the following correction increments subtracted for highly volatile bituminous coals:

Each 1 per cent ash multiply by	0.005° F.
Each 1 per cent sulphur multiply by	0.010° F.
Each 1 gram accelerator ($KC10_3$)	0.234° F.
Electric fuse	0.014° F.
Hydration factor (water in chemical combination)	0.045° F.

In preparing coal specifications the moisture, volatile matter, ash, sulphur and fixed carbon must be carefully considered, but as in Government contracts, coal is purchased on a dry basis, as has hereinbefore been stated, the limits for moisture have not been prescribed.

By close inspection of a hundred or more analyses of Illinois coals, the following characteristics are evident:

1. Illinois coals are uniformly high in volatile matter, and low in fixed carbon.

2. The volatile matter and fixed carbon vary inversely, and coal high in volatile-matter runs low in heat units, and therefore a high fixed-carbon content is an index to heating value.

3. Coal with high ash runs high in sulphur; also the ash and sulphur contents vary directly with each other and inversely with the heat value.

In view of these facts and of the necessary qualities of good steaming coal, the U. S. Engineer Office specifications are limited to a consideration of the ash, and the B. t. u. of the coal. In this manner, the amount of heat the coal will furnish per pound, and the residue after combustion are obtained; the fixed-carbon, volatile-matter, and sulphur being accounted for in the gross B. t. u. derived in the bomb calorimeter, as in the fire box itself.

In view of the inverse ratio between the ash and B. t. u., seconded by a knowledge of the mines from which the coal comes, there is in this vicinity a strong tendency among local consumers to purchase coal on an ash basis alone. The practicability of this

suggestion is doubtful where large quantities of run of mine coal are required, and it is believed that this method of test is better adapted to the purchase of screenings.

A careful study of the tests which have been made of Illinois coals has resulted in establishing the following specifications for the three standard grades:

1. Screened lump: The coal shall have passed over screen openings 2 in. square, and shall not contain more than 10 per cent slack, 12½ per cent ash, nor less than 12,000 B. t. u. per pound dry.

2. Run of mine: The coal shall be the entire unscreened product, as mined under normal conditions, and shall not contain more than 40 per cent slack, 15 per cent ash, nor less than 11,500 B. t. u. dry.

3. Screenings: The coal shall have passed over screen openings ¼ in. square, and not contain more than 60 per cent slack, 22½ per cent ash, nor less than 10,000 B. t. u. dry.

Slack, in these grades, is defined as all coal that will pass readily through screen openings ¼ in. square. The amount of slack in each delivery can be estimated with a fair degree of accuracy, but, if necessary to determine the grade, actual screening of a sample should be resorted to.

A delivery of coal offered in one grade, containing more slack than is allowable for that grade, may be accepted for use, but will be paid for in the lower grade to which it belongs; and the contractor, provided he has no contract for such lower grade, shall be paid therefor at a price based upon the relative prices for the same grades of coal at the nearest point where such contracts are in force.

Should the number of B. t. u. in any delivery, as determined by analysis, fall below the limiting number guaranteed by the contractor, deductions for such deficiencies shall be made from the contract price as follows:

Deficiency, B. t. u. per lb., less than guaranteed minimum.	Deductions in percentage of price bid for each 100 B. t. u. to nearest 100 B. t. u. deficiency.
50— 549	1 per cent
550—1049	1¼ per cent
1050—1549	1½ per cent
1550—2049	1¾ per cent
2050—2549	2 per cent

Should the percentage of ash in any delivery, as determined by analysis, exceed the limiting maximum guaranteed therefor, further deductions of five per cent of the price bid shall be made for each one per cent of excess ash.

Standard specifications have been issued recently by the Bureau of Mines in which the canvassing of bids for award of contracts and fixing of penalties is adjusted to a comparative basis of 1,000,000 B. t. u. and the ash to an arbitrary scale. The criticism, in part, is that in canvassing the bid for heat value, the adjusted value of the coal corrected for moisture is multiplied by 1,000,000 and divided by the product of 2240 multiplied by the number of B. t. u. guaranteed. This method, however, does not convey any fixed idea of unit cost factor to a business man, nor bear any other relation to fuel calculation, and an expression of B. t. u. to be received for each cent (or dollar) in payment would be more easily comprehended than a price stated for 1,000,000 B. t. u. In adjusting the grades with reference to ash the comparison is based on the highest percentage of ash acceptable under specifications. In this manner the most inferior coal offered is taken as the standard for comparison, and on any fluctuating price in the bids from one year to the other, prevents a comparison of prices. In payments the ash is given an arbitrary fixed value of 2 cents a ton penalty for each one per cent above or below the grade guaranteed by the bidder. This scheme is probably best suited to coals of the eastern fields, in which the ash is uniformly low and its variation small. Owing to the "limey" nature of the Illinois coals, the tendency of the ash to fuse and clinker, and the consequent choking of air passages through the grate bars, a high percentage of ash is very undesirable as it reduces the efficiency of the boiler. A differential of 2 cents a ton is therefore purely arbitrary and without direct relation to the value of the fuel.

The heating value of the Illinois coals under consideration has been examined graphically in relation to their ash content, and the resultant curves show that the value of coal with 35 per cent to 40 per cent ash content, although still containing 2,000 to 3,000 B. t. u., is worthless for steaming purposes. Steaming tests conducted by the Bureau of Mines have confirmed this. Therefore, 40 per cent ultimate analysis of ash has been accepted as the per cent at which the value of coal as fuel disappears. As the average ash content of these coals is about 15 to 20 per cent,

it is evident that the rate of loss in value is fairly represented by a reduction of 5 per cent in price for each 1 per cent excess ash above these average contents.

In comparing bids, all the variables—ash, calorific value, and price per ton—should be merged into one figure, the number of B. t. u. furnished for 1 cent. Accordingly, the following formula has been devised in which the inverse ratio between the ash and the calorific value has been maintained and reflected in the cost of heating value for a standard commercial unit:

$$\frac{TU}{p - \left[\frac{(A - G)\ p}{E}\right] + b + rm} = V, \text{ in which}$$

T = pounds per ton (2000 lb.)
U = B. t. u. per pound, limiting minimum guaranteed by bidder.
p = price per ton expressed in cents.
A = maximum allowable percentage of ash.
G = percentage of ash, limiting maximum guaranteed by bidder.
E = percentage of ash at which value of coal as fuel disappears = 40 per cent.

Fixed charges:
b = rate per ton for barge service = 20 cents.
r = rate per ton-mile for barge towage—¼ cent downstream and ½ cent upstream.
m = miles of barge towage to point of delivery.
V = comparative heating value or number of B. t. u. offered by bidder for 1 cent at point of use.

To illustrate the formula and show its significances, the following bids are compared for run of mine coal:

Company.	Price per ton.	Guaranteed ash, maximum.	Guaranteed B. t. u. minimum.	Method of delivery.
A	$2.00	13 per cent	11,500	Cars
B	$1.70	15 "	11,000	"
C	$1.60	15 "	11,500	"

Case A:

$$\frac{11{,}500 \times 2{,}000}{200 - \left[\left(\frac{15 - 13}{40}\right)\ 200\right]} = \frac{23{,}000{,}000}{190} = 121{,}000 \text{ B. t. u. for 1 cent}$$

Case B, by above formula, 129,400 B. t. u. for 1 cent.
Case C, " " " 143,800 B. t. u. for 1 cent.

Coal "A" compared in price with coal "C" has same number of guaranteed B. t. u. with a difference of 2 per cent in ash, and for each 1 per cent ash difference the coal by inspection is actually worth five cents per ton less, leaving $1.90 a ton as its relative value. Coal "B" is similar in ash with coal "C," but has 500 less B. t. u., consequently on a basis of 1 per cent for each 100 B. t. u. the value of coal "B" is lowered by 5 per cent of $1.70 or 8½ cents, leaving $1.62½ per ton as its relative value. Thus the contractor overrated coal "A" 10 cents a ton, and coal "B" 8½ cents a ton. It is evident that coal "C" containing 143,800 B. t. u. for a cent was awarded the contract.

DISCUSSION.

Mr. Fish. When you get a supply of coal and take a sample—then you work out the number of B. t. u. for each one cent?

Mr. Goldman. This is only used in comparing one bid with another to determine award before the contract is let.

Mr. Fish. You do not use that in working up the determination?

Mr. Goldman. No, we fine them 5 per cent for each .1 per cent excess of ash, and there is also a fine for a deficiency of B. t. u. The formula is only used in comparing bids.

Mr. Fish. You use the formula in deciding who you will give your bid to, and then fine them if they fall down?

Mr. Goldman. Yes.

Mr. Fish. Do you allow them anything if the grade is better?

Mr. Goldman. No, since we do not set the standard for their coal but allow them to set their price for the coal.

Mr. Hunter. Staunton and Carterville are the only mines I know of in this whole district that have less than 18 per cent ash, and it sometimes runs 25 per cent, so you will only allow one or two mines to bid on that. Only one mine that I know of outside of Carterville. The Carterville District runs between 10 and 14 per cent ash. There is only one mine that I know of in the upper district here that could supply the Government with coal according to your specification.

Mr. Goldman. We have been getting coal locally that runs 15½ to 16½ ash from St. Clair County. Some of the coal on first shipment to these specifications ran 18 to 20 per cent ash.

Mr. Meier. Could not any mine take the bid and pay the fine afterward. As I understand Mr. Goldman, they use this formula in determining which mine they will give the business to, and then these different values are checked up, and if the mine falls down they are subject to a fine of 2½ per cent.

Mr. Goldman. We have purchased some coal lately from Perry County. The first shipment ran 20 per cent ash. The fines amounted to about 40 per cent on B. t. u. and ash, and they immediately began shipping good coal. There are poor grades of coal in a seam. The upper grade will run 12,400 B. t. u., but the lower grades will run down to 9,500. You see, we have old style hand-fired steamboat boilers and we cannot use coal running high in ash.

Mr. Hunter. We are very fortunate in having with us one of our members who is a Mining Engineer. Mr. Wheeler, can you add anything?

Mr. Wheeler. I would like to ask Mr. Goldman the actual results he finds after he has made his contracts, as to how close they can live up to their specifications. What does he find to be the commercial variations? As I understand it, you sample each lot, do you not?

Mr. Goldman. Yes, each shipment is sampled in strict proportion of one pound for each forty tons of coal delivered.

Mr. Wheeler. What do you find the commercial variation to be in those different lots?

Mr. Goldman. Well, one company ran for three months steady at about 20 per cent ash. A representative came to see about it, and wanted to know what could be done to help them out, and he was told nothing could be done except compliance with contract. We told them they had better find out what quality of the coal was in the mine. So they must have taken forty or fifty samples and sent them to the University of Illinois. Then, they took some of our samples and found that the sample they themselves took from the mines ran lower than ours, and they started shipping us coal from Perry County. As a matter of fact, they had never analyzed their own coal, and stated that they had bid as they did, through ignorance as to the heating value of their own coal.

Mr. Wheeler. I thoroughly appreciate the efforts the Government is making, but they have still got to recognize the practical conditions under which we have to buy our coal, and it is im-

material as to who gets the coal and the efforts that may be made to try to hold up the standard. There is an insignificant little party of whom the Government is so afraid they don't dare to mention their name, and that is the Coal Miners' Union. If they felt like it, they could make your coal run from 20 to 30 per cent ash, and the mine owner is helpless. He may induce the miner to leave it out, if the fellow is good natured, but if the fellow does not feel like it he is unable to discharge him, and he has simply to grin and bear it. Illinois is the greatest union State in the country and the union dictates and determines just what grade of coal you get. It is a most unfortunate condition, and every operator in Illinois is simply a slave of that union, so what a man can do and what he is able to do is simply a question of what the miner happens to be able to do for him. They have a shift over them all the time to see that they clean all the coal. Most of the coal coming into St. Louis comes from No. 6, and it has two or three veins that are pure and two or three veins that are impure, and in the old days before the union was so powerful, the miners insisted that the veins which run very high in sulphur were to be picked out and two or three slate veins were also to be picked out. Now that the unions are so strong, if times are good, the miner is utterly indifferent. It increases his tonnage and you have to gin and bear it, and the coal operator is simply helpless. If he discharges a miner he immediately has a strike on his hands.

Mr. Hunter. There is one privilege the operator does have, and that is he locates on top of the screens—they usually have cages over the front of the screens where the coal is going down —about four or five boys to pick the slate and sulphur out of the coal as it is going down, but that is about all the operator can do. They also have their mine bosses there. As we all know, the upper strata is heavy in slate and they are liable to bring down a layer of slate 6 or 8 inches thick. Then in the bottom of the seam it is heavy in clay, and it is so much easier to pick into the clay than it is to pick into the coal, that the result is you get a great deal of clay with the coal. The miner is paid so much per ton for material coming to the pit head and he gets his wages whether it is slate, clay or coal.

Mr. Fish. The determination of heat units in coal is one that has been worked at for a good while, and I presume that some such scheme as this, in the long run, works pretty fairly to

the justice of both parties. What I am particularly interested in, however, is the absolute determination of the heat value of the coal. So far as I can learn, that has not as yet been arrived at. There is unquestionably more or less error in the selection of the sample and in the testing of the sample. Just what that percentage is I do not suppose anyone knows, but I presume it is there. It seems hardly reasonable to suppose that in determining the heat and ash in a thimbleful of coal that it will represent the percentage of ash and heat absolutely. It is the fashion nowadays to demand of boiler manufacturers guarantees of performance. It is absolutely impossible for a boiler manufacturer or any one else to forsee just what the condition of the performance will be, and to say exactly what his boiler can do under conditions that he does not know, as they cannot be determined, and yet those guarantees are asked, and even made, within a fraction of a per cent. Tests are run and the results calculated to within three or four decimal places. To my mind, it is a great engineering absurdity to do it, for the simple reason that this determination of the heat value, on which these results are all based, cannot be determined within some percentage or other. What it is, I do not know. I should like to know from Mr. Goldman whether he has any idea as to what percentage of error the results of any one determination are likely to range.

Mr. Goldman. We try to check to 60 B. t. u. on our machine. I understand there are other concerns here in town that figure down to 10 B. t. u. We figure our penalties down to 49 out of a hundred. We allow the contractor the other 51.

Mr. Fish. That is on your determination of the sample, but how closely does each sample represent the total amount in the coal?

Mr. Goldman. It is all in the sampling.

Mr. Hunter. There is a great deal in the moisture, too. In one particular case, we had four cars of coal taken out of the mine, and inside of 48 hours I took half of each car and ran a test on one of the boilers with that coal, and we averaged 5 lbs. of water per pound of coal. I took the other half of each car and unloaded it outside and let it lay there for two months. Then I took that same coal that had developed 5 lbs. of water per pound of coal and brought it into the boiler room, burned it under the same boiler, under the same conditions, and got only 3.25 lbs. of water per pound of coal. It was dry, of course. I brought the

moisture in that coal up to 11 per cent, and we got a higher evaporation with the added moisture to the dry coal than we did with coal just out of the mine. We averaged just 5.01 lbs. of water per pound of coal.

Mr. Hobein. May I ask what that coal ran?

Mr. Hunter. That coal ran 10,500 B. t. u., and varied about 70 B. t. u. in running the test dry. We find that the only way you can burn the Illinois coal is by the addition of 4 to 5 per cent moisture, otherwise you cannot do it. Mr. Fish brought up a point there in connection with guarantees on boilers. I think there are only two points he ought to consider in his guarantee. One is the draft over the fire which, with Illinois coal, must be high to burn it at all, and the other is the percentage of ash. I do not think he ought to care at all what the B. t. u. is,—that he can make the guarantee on his boiler with the percentage of ash and the draft over the fire. I am sure that there is not one of the boilers that would not run over 100 per cent, if they give him the draft, but the Illinois coal must have at least .5 over the fire.

Mr. Fish. Not so very long ago we had an experience that would illustrate my point regarding the determination of the heat value of the coal. This was an actual case and is one of the circumstances that have made me rather skeptical about this whole thing. There was a car of coal brought in for the specific purpose of making a boiler test. An accurate test was made by driving a pipe down and that sample showed 9,500 B. t. u. per pound. That coal was then unloaded in a shed and the part that was to be used for the test was shoveled over, and every fourth shovel was thrown aside as a sample, about 25 per cent, and the heat determination of that was about 10,020. That was merely as a preliminary to get a sample before the test was run. During the test, the coal was shoveled over as it had been before and that heat determination came out 10,780. Now what was the absolute heat value of that coal?

Mr. Tenney. This coal, when standing for a short time, will dry out and as it is handled from one time to another the clay will come out and every bit of waste matter that does come out increases your B. t. u. per pound.

Mr. Fish. That could not have been helped because I think it was the next day that these two determinations were made.

Mr. Hunter. There is one condition that might happen there, and that is the location of the chutes into that car when the coal

was being delivered. Often times, it depends on how the chute is laying. or how the car is placed under the chute. The nut coal will run to the sill, and in the center you will get a great percentage of slack. That would give you a lower initial value of your coal, and then by turning it over possibly you run into some nut coal, and in quartering it again you may have got some better coal.

Mr. Schuyler. In buying coal for the city,—the purchases amount to about 12 to 15 cars a day. We hardly expect to get a close value on any one car, but we feel by entering into annual contracts that both the city and the contractor will receive substantial justice by the end of the year. We make no claims at all, to reporting the value of the car. We report the value of the sample, and feel that the greater number of samples taken during the year will give the contractor, on the average, the corect price for his coal. I have noticed, however, during a month, when the atmospheric conditions have not varied to any great degree, that the reports sometimes will show the coal varying, on 30 or 40 samples, not more than 80 B. t. u. Now that speaks very well for the testing, and certainly well for the sampling. We buy lump coal and also screenings. The specifications for lump coal call for 11.000 B. t. u. per pound. In figuring the price, we divide the delivered B. t. u. specified by the B. t. u. and multiply the result by the price bid. That gives us the price that the man gets, the figure that shows on his bill.

Mr. Hunter. There was a paper read before the Western Society of Engineers on this subject by the Chief Engineer of the Commonwealth Edison Co. He had made several tests and investigations and found that coal at 40 per cent ash had no value, and some of the coal we have had from our district ranged about 36 per cent in ash, and unless you have a very high draft you cannot burn it. You have to have high draft with the increased per centage of ash or it is impossible, with any kind of boiler, to get it to make steam. We have a curve that illustrates this, and it was from this curve that Mr. Mitchell and Mr. Goldman included this 40 per cent in the Government specifications. That curve is very valuable to any one who is using our coal. You can readily see that you cannot get the full value of the coal when your ash runs above 20 per cent. The heat value of your coal is reduced, although you are buying it on the B. t. u. basis. A great many people in the East and Chicago say if we had your cheap coal we

could do very much better than you do, but they never take into consideration that the heat value of the coal is much reduced by ash, and in our case you have to burn a great amount of coal to get the full value of it, which entails a great amount of labor. Then we have a greater percentage of ash which also entails a greater amount of labor, so you cannot get the true value of the coal, and this curve has done more to relieve me in that situation than anything I know of. I think we were one of the first in the West that bought coal on the ash basis, and we use some 40,000 tons per month. We first put the amount of ash at 25 per cent and then 22½ per cent, and when I asked for 21 per cent they refused to bid on it.

Mr. ———. With that 0.5 draft, how much do you burn per square foot of grate surface?

Mr. Hunter. We have burned as much as 55 lbs. per square foot, with shaker grates. The carbon in the ash will run down as low as 16 or 17 per cent even at 54 lbs. per square foot of grate. Now you take that same coal with 0.4 draft and you cannot burn more than 28 or 29 lbs of the same coal, and you will have a higher percentage of carbon in your ash, if you get any value out of it at all. In some cases we will run up as high as 8 or 9 inches, and with the lower draft you can only burn 4½ to 5 in., and the general appearance of your fire looks like so many sparks coming out of it. It is a very interesting subject, the burning of our western coal, and if I was a boiler manufacturer I would sell my boiler absolutely on the draft basis.

Mr. Fish. If you could persuade the other fellow to buy it that way!

Mr. Hunter. Well, I could make them buy it that way, from the fact that the stack, as a rule, is always the height we want, and costs about $1. per H. P., $1 to $1.25 per H. P., and it is very small compared with the cost of your boilers, and the maintenance is less with a high draft. It is surprisingly so, but you get better results all the way through with your boiler.

Mr. Fish. I wish there were more Engineers that thought that way.

Mr. Hunter. Well we have gone all through that. I went to Chicago some seven years ago. We had a good deal of trouble with our Heine Type Boilers, and were getting about .24 draft over the boilers, and we could not get a higher draft over them. I heard of this Comonwealth Edison Station in Chicago, and I was

advised to go there and see how they did it. I had not been to Chicago and I went up there. I got off the car and saw their station with the high stacks. I did not go into the station,—I came back to St. Louis and increased our stack; our draft to .5 and our efficiency 100 per cent. Efficiency is another point to be taken in boiler work. A great many engineers think the efficiency drops down with the increased capacity, but I have not found it so. As the capacity increases the efficiency rises with it, so boiler construction and installation, and the class of coal have a very close bearing with each other.

Mr. Hobein. Relative to that method of sampling by driving a tube into a car of coal,—I have often observed when getting samples that way,—particularly in sampling mine run coal,—that there is a very small proportionate sample obtained in the tube. It seems to me in driving the tube down through the coal you strike a lump of coal and instead of the coal coming up in the tube in the form of a core it seems to be pushed down in the car, so from my experience I do not think it is hardly fair to say that in sampling coal in that way that you can get an average core all the way through the body of coal which is in the car. For instance, if there is 5 feet of coal, I do not think that you get a 5 foot core in your tube, by any means or an average sample all the way down through the core. Of course, where you are sampling one or two hundred cars, and buying on 2 per cent, it may average up so the coal man gets a fair deal. One time I started to experiment a little to see if I could not devise some sort of auger arrangement, so you could just pull a core up into the tube and hold it there, but I did not have any success with that, and I wondered if anybody else had had any experience along that line.

Mr. Schuyler. The tube is only adapted to lump coal. You cannot use it on mine run. Mr. Otto Kline, of the New York Testing Laboratory, tried it on the grades of coal they get around there and had no success with it at all. I do not think you can use it except with the Illinois coal and lump coal.

Mr. Hunter. We use it entirely in our plant on mine run coal.

Mr. Tenney. We made a series of tests on those pipe samples, taking three cars and testing them three different ways,—first by driving the pipe down in four places; the second by driving it in five places and the third in ten places. We assumed that the ten-point method was the most accurate because it was a

more uniform sample of the whole car, being taken at more places. Then we compared the results in B. t. u. and ash and found that the four-pipe method compared almost identically with the ten-pipe method, while the five did not agree at all and that is due to the way the cars are loaded at the mine. The coarser coal, in the loading, rolls toward the sides and toward the end, and you could almost figure out which one of those methods was going to come out right, and we decided that the four-pipe method was the best.

Mr. Hobein. I have found that the tube method works very well with screenings, even better than with the lump coal, where you have to break the lumps. It seems to me you get a very fair result with screenings.

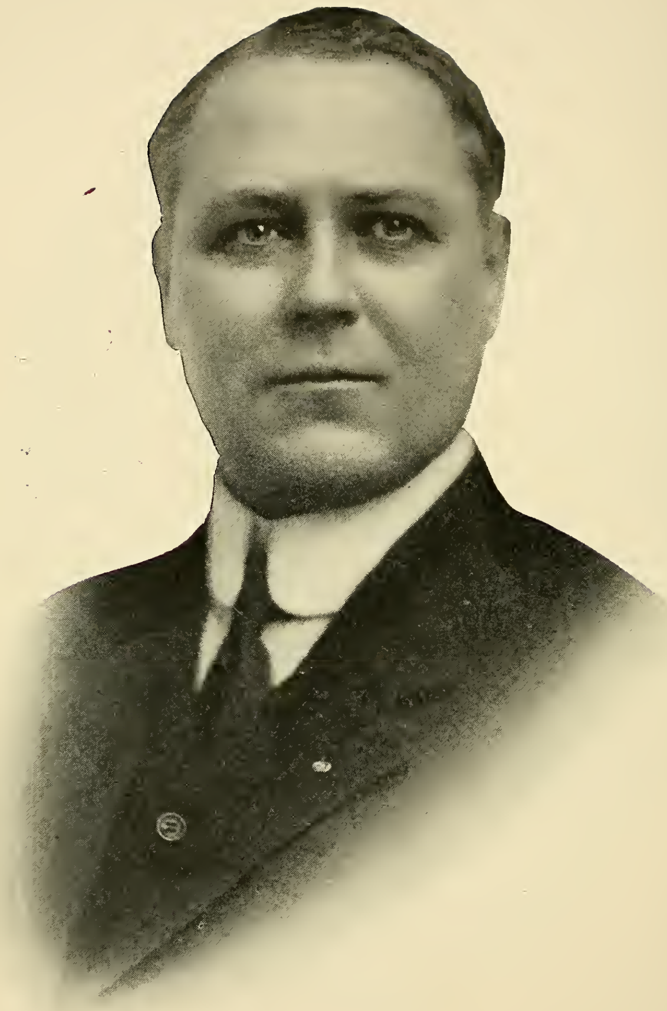
Mr. Tenney. I might say that with mine run coal, what Mr Hobein says is true.

Mr. Hobein. It seems to me there is a great chance there to get up a scheme to get a better test of mine run coal. It seems to me that the present method is very poor.

Mr. Hunter. I agree with Mr. Hobein, from the fact that we find it impossible to get through some of that coal with an auger.

[Note.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, by February 15, 1914, for publication in a subsequent number of the Journal.]

J. H. Armstrong, *President.*
Civil Engineers' Society of St. Paul.



EDW. J. BURDICK, *President,*
Detroit Engineering Society for 1913-1914.

Editors reprinting articles from this Journal are requested to credit the author, the Journal of the Association, and the Society before which such articles were read.

Association

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EDITORIAL.

Our new cover seems to have met with general approval,—at least we feel much gratified at the number of favorable comments which have been received. Doubtless there are some who prefer the old cover to which they have been so long accustomed, but we have not heard from them. The appearance on the cover in prominent type of the names of the societies constituting the Association will contribute toward a feeling of ownership in the Journal, which some of our members felt has been heretofore lacking.

Some criticism was received from one member because the stenographer's report of his discussion on "The Status of the Engineer" was not submitted to him for revision before publication. This is regretted but for several reasons was unavoidable in getting out the first issue on schedule time. A continuation of this discussion by ten members in this issue was revised by the contributors and will be found a very interesting discussion of a very live subject.

In response to last month's editorial soliciting suggestions as to the character or policy of the Journal we must report that no suggestions were received from outside of St. Louis and only a few from local members. These we wish to submit with the earnest hope that we may receive some expressions from other members,—either in approval or disapproval.

It has been suggested by several that we maintain a depart-

ment of "Letters to the Editor." While letters on any subject would be welcome it was suggested that special efforts be made to secure letters from subscribers who are living away from the large cities or who are making trips through countries or regions not familiar to most of the members. Such letters need not be confined to engineering but may describe such local conditions, modes of life, and personal experiences as might prove of general interest.

Another suggestion, the only one received in writing, is as follows: "How would it work to have a column of 'Personal Items.'—the material to be furnished by the different clubs and giving such information about members as the other clubs would be interested in?"

Under the present Rules of the Board of Managers the matter published in the Journal must be restricted to:

(A) MONTHLY.

1. Papers submitted by the societies for publication, including presidential addresses and memoirs of deceased members.
2. Proceedings of meetings of the societies.
3. Lists of officers of the Societies.
4. List of members of Board of Managers.
5. Advertisements.

(B) ANNUALLY.

1. Annual report of Chairman and of Secretary of Board of Managers.
2. Articles of Association, Rules of Board and rulings of Chairman.

(C) BIENNIALLY.

Report of Auditors.

If the suggestions given above, or any others, meet with general approval, they will be submitted to the Board of Managers by letter ballot so that the Rules may be modified, if found desirable.

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Portraits of the presidents of two of our constituent societies are presented in this issue. Others will follow later.

THE STATUS AND DUTY OF THE ENGINEER.

By J. A. Ockerson,* Member Engineers' Club of St. Louis.

[Read before the Society, January 7, 1914.]

Mr Edward E. Wall's paper on the "Status of the Engineer" is a well written account of what he conceives to be the shortcomings of the engineer and the weak points of the profession, and it doubtless has its useful side in calling attention to certain deficiencies in our practice. In some respects we may agree with the author and the lucid, forcible way in which he has presented his views is deserving of the highest commendation.

But are we ready to accept such sweeping condemnation from even a prominent member of the profession without exacting from him an account of his stewardship in behalf of the engineer?

It is true that the term engineer, as generally used, has too wide a scope in the popular mind, and but few are familiar with that technical significance which means "one who converts the materials and forces of nature to the uses and conveniences of man."

Frequent efforts have been made to find an acceptable term, explicit in its meaning, which could replace the word engineer as applied to the professional man engaged in engineering to-day.

But engineering as we know it is still young, while law, medicine and theology have existed since the dawn of time. Lycurgus and Moses, the first exponents of law and theology, and Aesculapius, the mythological father of medicine, belong to the remote past, in the early beginnings of history.

In this country, engineering has as yet hardly compassed its first century, and its accomplishments thus far fully justify our faith in its future.

If Dr. Wiley's prophecy as to the effects of the pure food law is fulfilled, the three so-called learned professions will disappear, and then the engineering profession will come into its own as the only learned profession in existence.

He argued that disease is caused by the use of impure foods. Enforce the pure food laws and abolish the use of impure foods and you eliminate disease. This being done, there would be no

*Consulting Engineer and Member of Mississippi River Commission.

further use for doctors. Crime is largely the result of disease, and when the latter is eliminated, crime goes with it, hence the lawyer loses his occupation. When both disease and crime have disappeared, humanity in general will be essentially good, and there will be no further need of the clergy to point the way to heaven or picture the horrors of hell.

The materials and forces of nature must, however, be converted to the uses of man, and this falls to the lot of the engineering profession, and puts it on the pinnacle of usefulness to humanity where it cannot fail to be seen, recognized and applauded.

Membership in the American Society of Civil Engineers does clearly mean a certificate of ability, based on the best of all evidence, the actual work which the candidate has accomplished. While some unworthy members may have been admitted in the past, and will be in the future, these are exceptions that rarely occur.

The same is true of the diplomas and degrees awarded to graduates. They simply certify that the graduate has pursued certain prescribed studies and has been proficient therein. It is difficult to see why the "immortal gods" should be so over-hilarious on witnessing such commencement ceremonies.

The "man on the street" is not as a rule an employer of skilled engineers, and it is not important that he should know just what membership in a National Engineering Society means. Men conducting large business enterprises or heading large corporations which require the services of engineers have no difficulty in identifying them, and this, too, without the necessity of maintaining publicity bureaus by the several societies.

The Board of Direction of the American Society of Civil Engineers have at times been asked to name competent men for certain specific work. Some of these requests came from foreign countries, through our Department of State. In response to such requests a list of men who have had experience in the line of work required, is usually sent out, and with good results.

Publicity bureaus have been frequently suggested and discussed by the Board, but have not been regarded with favor.

Active press agents are often employed to bring individuals or measures to the attention of the public, but unfortunately such publicity is also often used for unworthy purposes.

We must agree with the author that the necessities and comforts of our cities, as well as the country at large, are due to the work of the engineer, and doubtless his importance is too often overlooked, but we need not despair. The General Government, States, and Municipalities are coming more and more to publicly recognize the necessity of relying on the opinions, the plans and the work of the engineer. We heartily concur with the author in his advocacy of wider interest and participation in public affairs by the engineering societies, both local and National.

That there is a "growing dissatisfaction among the members of the American Society of Civil Engineers" may well be doubted, since the increase in membership is going on at a phenomenal rate. Is there a "general feeling that it is not doing for the profession all that it might do?" Do the members, if any, who feel that the "only benefits derived are a few publications" and the privilege of wearing a badge, make any efforts to aid in developing an ideal society? The usefulness of the Society is manifestly dependent on the activity and interest of the individual members therein. So it must be apparent that the member that grumbles at the benefits he receives without offering or attempting to eliminate what he regards as defects, has slight grounds for complaint.

It is not uncommon for citizens of a community to criticize the officials who direct its affairs, and yet they never interest themselves in the elections, not even to the extent of voting. It is needless to say that such criticism receives scant attention and elicits little sympathy.

The most remarkable statement made is that the value of its publications are "yearly deteriorating." How can such a statement be seriously considered when we know that the experiences of the best engineers in the most important works going on in the country are to be found in its transactions.

If they are deteriorating, it must be the fault of those who are not doing their duty as members by supplying papers that will be up to such standards as they deem fit and proper. The facile pen of the author himself, as shown by his paper, demonstrates that he could readily contribute a paper worthy of the highest standard. It is to be hoped that he will do his share towards halting the deterioration of which he writes. He already holds

a medal for an excellent paper presented to the American Society of Civil Engineers in 1908.

Another astounding statement which he quotes, that could only come from one with a very limited horizon, is that the "honor of membership" in the American Society of Civil Engineers "is slowly losing its prestige." If it is not an honor to become associated with the leaders in the profession, on whose example and advice the status of the engineer in the public mind practically depends—if it is not an honor to belong to a Society whose membership includes the engineers who are at the head of the greatest engineering works now in progress—a Society large in numbers, whose influence is sought for and felt in many public movements for the comfort and convenience of man—then pray tell what kind of a society should a man belong to that would be worthy of his membership.

No organization can properly lay claim to perfection, and while the national engineering societies are no exception to this rule, they cannot be regarded as conspicuous delinquents therein. None of them have reached their fullest development, which is the ideal condition, but all are progressing. Members of the American Society of Civil Engineers are to be found in nearly every community in our own country, and in many foreign lands, and its publication have even a broader distribution.

The financial condition of the Society has reached a stage where research work has become practicable, and it is steadily enlarging its sphere of usefulness in this and other fields. In the meantime its influence has reached an enviable status of which its members should be proud.

The Board of Direction is composed of thirty earnest, progressive, up-to-date men, most of whom are in active practice, who are alive to the interests of the Society and are ready at all times to give careful consideration to definite, tangible suggestions regarding the betterment of the status of the engineer through the activities of the Society.

While the Board is conservative, as it should be, antiquated ideas receive scant homage, and policies which do not meet the requirements of the day are discarded when good and sufficient reasons can be shown for such step.

One can scarcely avoid the conclusion from the author's statements that the desired "step forward" he has in mind refers to the establishment of an employment bureau, devoting its

energies to a glorification of the engineering profession through the agency of a publicity bureau. This view assumes that a society is something distinct and apart from its membership, which cannot be true. If personal gain is the sole object of membership, if the individual has no feeling of interest in or obligation to his fellow members, then the employment bureau would perhaps answer the purpose.

But such a society would be merely a rope of sand. A successful society must have members proud of their organization, devoted to its advancement and jealous of its reputation as well as that of the individuals belonging to it. The member in such a Society will defend it when assailed, will devote his best energies toward increasing its usefulness and influence for the betterment of the profession as well as its clients, and will be proud of his badge of membership. The "status" of a society is just what its members make it, and the "status of the engineer" cannot be fixed by a society as an organization.

There is no doubt that the engineer fitted by years of experience to design and construct important works is often very poorly paid for his services. For the first few years after graduation the pay is rather larger than in other lines of work. This has its advantages, as it gives the young man a chance to get his bearings, and in case he develops qualities that better fit him for other more lucrative fields where his engineering studies and practice will still be of value, he should not hesitate to change before his habits of thought and action become fixed, in other words, before he gets into the proverbial rut.

In all walks of life, however, the law of supply and demand must largely govern, so the energies of the profession must be devoted to increasing the demand by convincing the investing public, engaged in developing new enterprises, that the employment of competent engineers is essential to successful developments, and satisfactory profits.

Those seeking to develop great enterprises do not seek cheap engineers, but look for the men with the largest experience, whose judgment can be relied on, and the price to be paid for such services is a matter of secondary importance to the employer.

The engineer in fixing his fees might take his cue from those members of the American Society of Civil Engineers whose pro-

fessional services reach the sum of $150,000 per annum, although it must be confessed that they are very rare.

The anecdote of Prof. Hassler, the first Superintendent of the U. S. Coast Survey, illustrates conditions when engineering began in this country. It is related that Hassler went to the President and stated that his compensation was not commensurate with his services, and he wanted a higher salary. Said the President, you get as much as the Secretary of the Treasury, now. That is all very well, said Hessler, you can get plenty of men for Secretary of the Treasury, but there is only one Hassler,—only one. The story is silent as to the result of this interview, but it seems probable that the request of Prof. Hassler was granted.

It is true that not only engineering societies, but the world at large, do honor to those who have won their way to the front. That is an incentive to ambitious men to do their best, and when they have won distinction by their own honest efforts they are certainly entitled to the approval, the plaudits if you will, of their fellow men.

It is doubtless true that foreign engineers are more familiar than the American engineers, with other languages than their own. There is a good reason for this in the fact that the several contiguous States, quite small in area, have each their own language, and a few hours journey in any direction puts the European engineer in a foreign land. It is therefore a matter of necessity rather than an accomplishment, for him to know more than one language. That necessity does not exist in the United States. If it did, our engineers would doubtless also become linguists. Along the Mexican frontier will be found engineers familiar with Spanish. That necessity is the controlling element is shown by the fact that Europeans who acquire several languages, such as French, German, Italian, are very often lacking in English. The writer recalls an experience in the engineering section of the International Jury of Awards of the Paris Exposition, where there were sixteen members of the Jury from the several European countries, none of whom could speak English.

On the other hand, the inference that European engineers as a class are better educated than the American engineer, is hardly tenable. The writer has a large personal acquaintance with engineers, both at home and abroad, and does not find the foreigner

has any decided advantage on this score. It is doubtless true that individual practice in foreign lands is generally more restricted to specialties than with us.

"Beware of the man of one book," is a trite saying, and applying it to the engineer who limits his practice to a single specialty, he is quite apt to become so proficient or learned therein as to be looked up to as an authority. The best and most important engineering literature is translated into English, which is rapidly becoming the language of the world, and hence the American engineer can always keep pretty well informed as to foreign practice.

The tendency towards standardization of engineering practice in given lines is growing all over the world. Commissions of experts and engineering societies, even, exchange visits and ideas with us, each visit resulting in the adoption of new or the improvement of old methods. This interchange of experiences is far more potent than could be realized by mere familiarity with the engineering literature of the world.

The deliberate course of study from childhood up, which is sugested by the author, would doubtless contribute to broadness of mind and develop large capacity for study in later life, and result in that analytical quality of mind which is so necessary to a successful career. But something more than education is necessary. All minds are not of the same capacity, and in probably a majority of cases much of such extended training would be largely wasted.

Deplore it as we will, the "rank and file," the great mass of humanity, must always remain "hewers of wood and drawers of water." But the work of the laborer, the servant, the mechanic, the farmer, is just as honorable, just as worthy of approbation, just as much entitled to reward commensurate with the duties performed, as any who follow the professions for a livelihood, but there is room for comparatively few of the latter.

Instead of measuring success by the number of dollars that can be accumulated, it should be based upon honor, integrity and ability to do well the tasks of whatever nature that come to hand.

These are the proper standards to use in measuring the worth of the individual in every walk of life.

It is plainly evident to all of us that engineers as a class

are neither orators nor fluent writers. There are, however, exceptions, some even in this club, and the author of the paper under discussion has proven an alibi by reading us a forcible lecture on the shortcomings of our profession.

Here again necessity comes in. The calling of the lawyer and the divine, compels them to speak and write, and with much practice some of them become proficient in these lines. It is not because their early education is more thorough than that of the engineer. The latter has his formulas and his plans to work out in the quiet of his office, and while doing this there is no opportunity to develop a glib tongue, although some of our members are endowed with the faculty of ready speech.

As a matter of fact, orators and brilliant writers are only rarely found in any calling.

The charge that engineers as a class cannot write intelligible accounts of the work they are doing, is manifestly unjust, as is shown by the many admirable papers that are to be found in the transactions and journals of the profession. Among the annual addresses of the Presidents of engineering societies may be found some real literary gems.

The author in the closing paragraph of his paper shows that he still at heart has faith in the engineer and is proud of his profession. After endowing the engineer with all the attributes which go to prove him a failure, and giving him a good trouncing, he lifts him up and presents him as the "foremost man in civilization to-day."

His long, faithful and efficient services devoted to our City, his interest in our Engineers' Club, and his keen insight into our shortcomings, all justify our belief that we will find him a valiant champion of the profession, in the front rank of those successful, progressive engineers who are devoting their best energies towards commanding public recognition for engineering as the peer of any of the learned professions, to which it is even now clearly entitled for the invaluable services rendered in promoting the health, the comfort, and the conveniences of man.

The writer submits these few remarks, not for the purpose of criticising the author, but for the sole purpose of expressing his abiding faith in the engineering profession in which he has had the honor of laboring with more or less success for a number of years.

DISCUSSION.

MR. ROBERT MOORE:

The title of this paper "The Status of the Engineer," indicates that in the opinion of the author something is wrong in that status; though just what this is, I think he does not very clearly make out. Taking the opinions of the public in general as an indication of their beliefs as to the facts, I think we are entitled to say that the Engineer is not a failure. I know of no class of men who are more thoroughly and implicitly trusted. The client is in many cases almost obliged to accept the statements of facts made by his Engineer, and to adopt his recommendations almost without question. The necessities of the case compel it, and the result is that the employer is careful as to whom he selects as his engineer. It is more important for him to select a straight, honest, clear-headed man than it is to select a man of very high technical training.

The truth is—and I think this is one of the great merits of the Engineer's calling—that he is always upon honor. If he makes a false statement or a recommendation which is not well considered, he fails, and soon disappears from the ranks of the active men. He must be trusted and he, therefore, must be trustworthy or he cannot expect to succeed. And more and more it is becoming true that the judgment of the people is correct, and that the best man goes to the top. The best man usually wins, and on the whole, justice is fairly well done. And we need not fear that real merit on the part of the Engineer will fail of being acknowledged and accepted. In fact, I think the good Engineer—a man deserving the name—stands as high as any man in the community in either of the learned professions. More and more is the Engineer coming to the front, but he will get there only as he deserves to be there, and he will remain there only as long as he deserves to be there. We may very well trust him to take care of himself on the lines which he has followed hitherto. Success will come to him who deserves it and to him who does not deserve it, it ought not to come.

MR. J. W. WOERMANN: Mr. Wall's paper, I am sure, was exceedingly interesting to all of us, and while we may not agree with him on every point, it was certainly eminently successful in bringing out such an interesting and complete rejoinder from another highly esteemed past president, from whom we are always delighted to hear. Mr. Ockerson, on many points, has gone to

the other extreme, and we now have our limits established between which *every engineer* may select his own ground and erect his own standards.

Mr. Ockerson agrees with Mr. Wall in his comments upon the "bucolic mind" which fails to distinguish between a locomotive runner and the man who designs the locomotive—or between the county surveyor and the engineer who designs bridges, water-works and sewers—or between the foreman of a gang and the engineer in charge. However, I think we will all agree that a very marked improvement has taken place in this respect in the last twenty years, and that it will not be many more years before the engineer will be understood and classified as thoroughly as those of the other professions.

Concerning the qualifications of an engineer, Mr. Wall made some excellent remarks when he said that "It is not enough that he shall be expert in calculation and abreast of the times in his knowledge of the results of all the research work being done in his special field. He must be practical, and by that I mean he must be able to fit his designs to the circumstances of the case in hand. His proposition must be so framed as to convince the community, corporation or individual that it is the best of all conceivable plans. In order to do this he must know men, and to a certain extent, be able to play upon and take advantage of their peculiarities and weaknesses. He must be able to impress business men, legislators, officials and also other engineers with the excellence of his proposals, and inspire their respect for his knowledge and ability. To put it in a few words he must have good judgment—both of men and things."

I am sorry that Mr. Wall did not stop there. His next sentence—"To paraphrase Mr. Micawber, if he is right, in 51 per cent of his transactions, he succeeds, but if he is right in only 49 per cent, he fails"—I do not agree with that and I do not believe that Mr. Wall does in practice. I imagine that in order to hold a position under Mr. Wall that an engineer would have to maintain his average at 91 or over, rather than at 51 per cent.

Mr. Wall's criticism of American colleges, and his picture of a youngster marching up to the rostrum to receive his M. A. degree, should be taken humorously and not seriously. Such colleges may have existed a generation ago, but I do not believe that they exist now.

The establishment and maintenance of a publicity bureau by

the National Societies, it seems, has not met with the favor of the Board of Direction of the American Society of Civil Engineers. Possibly this is because the members of the Board have been so well established themselves that they could see no necessity for it. Possibly because they could not see any solution of the difficulties involved in carrying out such a plan. Possibly because Mr. Chas. Warren Hunt thought he was doing about all that should be expected of him for his salary of $12,000 per year. However, I believe that it should be referred to the Board for further consideration, and that a successful promoter and politician be employed to work out the details of operation.

Mr. Ockerson and Mr. Wall agree that practically everything of a communal nature that appertains to the comfort, convenience, luxury and necessity of the dweller in cities is due to the ingenuity of the engineer; so each member of the club is entitled to a bouquet on that point.

Now we come to Mr. Ockerson's sore spot—"That there is a growing dissatisfaction among the members of the American Society of Civil Engineers may well be doubted—*since* the increase in membership is going on at a phenomenal rate." Q. E. D.—Because it is growing rapidly does not disprove Mr. Wall's statement. If you do not join the American Society of Civil Engineers what other National Society of Civil Engineers will you join? It is manifestly better to join the only one we have, short-comings included, than to join none. We have hopes that its deficiencies may be corrected and its blemishes removed.

In regard to Mr. Wall's statement that "The honor of membership in the American Society of Civil Engineers is slowly losing its prestige,"—I confess that I was as much surprised as Mr. Ockerson. Doubtless because Mr. Wall has had his blue shield so long, it does not look so important to him as it once did. The same might be said of his college diploma. I believe, however, that the blue shield means much more than the college diploma, and that the standard of membership in the A. S. C. E. is higher to-day than it ever has been. I, for one, do not believe that the honor of membership is slowly losing its prestige.

The writer agrees with Mr. Ockerson that "A successful society must have members proud of their organization, devoted to its advancement, and jealous of its reputation, as well as that of the individuals belonging to it. The member in such a society will defend it when assailed, will devote his best energies

toward increasing its usefulness and influence for the betterment of the profession, as well as its clients, and will be proud of his badge of membership." That, in my opinion, is the best part of Mr. Ockerson's excellent paper. I dissent, however, on the unqualified statement—"That the status of the engineer cannot be fixed by a society as an organization." Individually, it cannot—no society can raise the status of an incompetent engineer to that of a successful one. It can do much, however, in raising the public estimate of the profession as a whole. The recent action of this Club in requesting Gov. Major to appoint at least one engineer on the Public Utilities Commission of Missouri, and in requesting Gov. Dunne to do the same for Illinois, was a step in this direction. As you all know an engineer was appointed on each commission.

All of our National societies in my opinion, might well emulate the example of the Junior Institution of Engineers of Great Britain, in compiling and maintaining a permanent Engineers' Register in which a complete record of the professional career of each member would be given. In the absence of any engineers' register in this country, I have found it worth while to preserve the monthly lists of applications for membership in the American Society of Civil Engineers, which gives each applicant's record for at least 10 years, if he is eligible for membership, and for at least 6 years, if he is eligible for Associate Membership.

An extended and interesting discussion on the status of the engineer was published some months ago by the American Institute of Consulting Engineers. On the subject of licensing engineers Mr. Samuel Whinery, the well-known consulting engineer of New York, made the following remarks, which convey my ideas better than I could express them:

"The disapproval by many thoughtful and conservative engineers of the several bills that have been introduced into the Legislature of this and other states, providing for the Licensing of Engineers has been largely based, not upon any opposition to the statutory recognition of Engineering as a Profession and the proper regulation of Engineering practice, but upon a conviction that the measures proposed were narrow and inadequate, and in some particulars at least so ill adapted to present conditions as to be actually impracticable. The specific objections to them need not be reviewed here, as they have been quite thoroughly discussed.

It may be safely assumed that the great majority of the reputable Engineers of the country would welcome and support a project for the official recognition of the Profession of Engineering and for the reasonable and workable regulation of professional engineering practice.

"It is the purpose of the speaker to outline very briefly some of the principles to be kept in mind, and to suggest a scheme of legislation and organization that would seem to meet the needs of the situation.

"In the first place, any such scheme should be broad enough to embrace and apply to all the different branches of professional Engineering. This proposition should require no argument.

"In the second place it should provide for the largest degree of control, within the Profession itself, of practical measures and methods for regulating professional organization, conduct and practice. In other words: there should be a minimum of statutory enactment and a maximum of administrative authority within and by the Profession.

"This is necessary because it would be as unwise as it would be impossible, to cover under any one fixed state law all the varying conditions and details that must be dealt with to properly and effectually control professional practice. There must necessarily be provided considerable latitude and elasticity, particularly during the earlier and to some extent experimental development of the plan, to adjust requirements to existing conditions, and to introduce changes and additions as the necessity for them might become apparent. In short, the state law should permit a large measure of what may be called 'home rule' in the Profession."

Then follow the provisions of such a proposed law which seem to be eminently practicable, but which I will not take the time to quote, except to state that the four great national engineering societies would each be represented upon the Board of Control, which would exercise general supervision and control over the professional practice of engineering in the state, and have power to organize and enforce a proper system of registration based upon such examinations or investigations as it might deem proper. So much for licenses.

In the matter of foreign languages, I think we are inclined to value them too lightly. As the International Congress of

Navigation in Philadelphia in May, 1912, the official languages of the Convention were French, German and English. At the opening session in the Metropolitan Opera House more than 3,000 persons were assembled, when the veteran mayor of Philadelphia, Mr. Rudolph Blankenburg, welcomed his audience first in French, then in German, and finally in English. Not a reading of a translation which some one had made for him, but a wholehearted royal welcome, with naught of repetition in either. An exceptional mayor, and a fortunate city! Several of our American engineers spoke in two languages, but their efforts were labored and painful. Some of the foreign engineers addressed the Congress in three languages and in the case of the Russian and Italian engineers, and some others, their native tongues were not one of the three official languages.

Speaking for my own line of work I am convinced that the best literature on navigable waterways is in French and German. A German work by R. Jasmund on the Improvement of the Rhine is a classic, yet few engineers, even among those engaged in river work, know of its existence, and the only translation I have ever seen of any portions of it were made by Miss Mary Klem in the rooms of this Club.

Mr. Wall's outline of an ideal education sounds very alluring, but figure for a moment upon the result. Enter private school at 6; graduation at 14; graduation from high school at 18; graduation from private school at 22; graduation from professional school at 26. Mother might not care, but what would father say? And think of the waiting sweetheart!

Mr. Wall's picture of the result of our incomplete and hurried education is too often true,—"a silent, awkward, self-conscious individual whose thoughts lie too deep for words." I believe part of the responsibility for our weakness in English belongs to the High Schools, and I believe that this condition is being changed. At least, I know that my daughter, at Soldan High, is having much more practice in English than I had at the old Central.

A special committee of the American Society of Civil Engineers which is investigating the conditions of employment and compensation of engineers throughout the country has compiled data on these subjects which must be of great interest to the entire profession. A circular in blank form asking a series of eight questions was mailed to 6,850 members with the assur

ance that the replies would be treated as absolutely confidential and destroyed as soon as the data was compiled. From the replies sent to the committee by 3,636 of the members three diagrams were platted, showing the minimum, maximum, and average yearly compensation for each year of experience. One diagram shows that the average remuneration at the end of the first year is $1,300. At the end of five years the average compensation is $2,000; at the eleventh year $3,000; at the fifteenth year $4,000; at the twenty-first year $5,000; at about the twenty-fifth year $6,000; reaching the highest general average of about $7,500 after about thirty years of practice. After that the average slowly declines, remaining above the $6,000 line, however, until after the forty-fifth year. The average for the entire 3,636 who replied is $4,325. It is an interesting fact also that for the first fifteen years the average compensation of the 1.972 who replied is $2,827. These averages are so much higher than I supposed they would be that the question has arisen in my mind,—are these 3,636 replies typical of the entire membership, or, in spite of the assurance of secrecy, did a greater proportion of the lower salaried men fail to send in their reports. The committee believes that the averages err in being slightly too low because where members receive subsistence, house-rent, and other perquisites, these were not included in tabulating the results. I believe that this preliminary report must be encouraging to the profession at large, and that the committee's complete report will be awaited with much interest.

The realization on the part of many of our engineers of their ability to take the lead in public affairs has resulted in considerable activity during the past few years on the part of engineers, engineering societies, and engineering journals in calling the attention of the profession to its latent energy and in proclaiming the fact to the public at large. The result of this activity is becoming apparent. Engineers have been appointed on public service commissions, not only in Missouri and Illinois but in a number of other states. Under the new commission form of government a number of engineers have been elected as commissioners, and in one city of Western Canada all three commissioners are engineers. The mayor, who is also the Commissioner of Finance and Safety, is a civil and mining engineer; the Commissioner of Public Works is a civil engineer; and the Commissioner of Public Utilities is an electrical engineer.

The recent appointment of an engineer to the position of City Manager of Dayton, Ohio, at a salary of $12,500 a year, is very gratifying to all engineers. This is in line with a well established practice in Germany where many engineers make a specialty of city management and advance from the smaller cities to the larger ones as their experience ripens. Dayton is the first large city in this country to adopt the plan, although two smaller ones had done so previously. More recently three additional cities, including Springfield, Ohio, have adopted the City Manager plan, but have not yet begun operations under their new charters. We hope the practice will spread rapidly as it will be a very potent factor in giving the engineer his proper status in the public mind.

I believe that engineers as a body are recognizing their shortcomings, and are rapidly overcoming them. I believe that the time is coming rapidly when engineers will be in the first rank of our professions instead of in the second or third rank; when many of our City, State and National Boards will be made up principally of engineers instead of lawyers and professional politicians.

Then let us all, individually and collectively, upon every possible occasion, devote our best efforts toward commanding public recognition of our ability to render public service intelligently, honestly and faithfully,—for public service, in office and out of office, will be the standard upon which all professions and all classes will be measured in the future.

Mr. Greensfelder.—Do you want to enter the discussion now, Mr. Wall, or do you want to hear from some of the others?

Mr. Edward E. Wall.—I think I can say what I have to say now. I did not expect when I wrote that paper and read it before the Club that everybody would agree with me, but I hardly looked for as much criticism as I seem to have aroused. However, if the paper has had no other effect than to bring out some four or five members that I do not think have been here for a long time, it was well worth writing for that alone.

Mr. Ockerson was kind enough to give me a copy of his remarks, which gave me an opportunity of going over them pretty carefully, but before I start on what I am going to reply to him, there are some points which were mentioned by the other gentlemen. Mr. Moore, in speaking of the employers of

Engineers, stated that they were very careful in the selection of the Engineers. That may be true in some cases, but I have in mind only one case out of a number that I know of, where a town council wanted an Engineer to design them a system of water works. They wrote to a number of prominent Engineers and had at least two from New York City, one from St. Louis, and one from Kansas City, and there may have been one or two others. Then they proceeded to let those men bid against each other to see who would take the job the cheapest, which seems to be the ordinary practice in those cases. The job finally went for $1200, I believe, so I do not think that, as a general thing, they are very careful in their selection of Engineers.

Mr. Woermann said something about the Engineer knowing foreign languages. I believe that the reason the Englishman and the American do not acquire foreign languages originated in the stubbornness of the Englishman, who would not do business with any one who could not talk his language. They had to come to him and learn his language or he would not do business with them, and he put that over on them,—the whole world,—and we have kept it up.

There was one point in Mr. Ockerson's talk that I have not covered otherwise, about the Engineer being able to read and talk proper English. This point I simply want to illustrate by saying that within the last week there was a committee, of which at least four were Engineers, that was arguing in support of a contention of their own before the Board of Public Improvements and. after stating the proposition, they wound up with a sentence like this:

"We would like to know what the Board of Public Improvements would do, under its worst aspect, in these circumstances?"

Now any of the members present to-night who did not hear my original paper might think from Mr. Ockerson's paper that I had made an especial attack on the American Society of Civil Engineers, but that is not true. At least, if it sounds that way, I did not mean it. I simply classed it with the other National Societies, and with the Engineers' Club of St. Louis.

If "One who converts the materials and forces of nature to the uses and conveniences of man" be an engineer as Mr. Ockerson defines him, then engineering is the oldest of all professions, and must of necessity have existed before theology, law or medicine. Engineers antedate Moses, Lycurgus and Aesculapius.

The problems confronting the prehistoric engineer were of the simplest construction and not involved with any considerations of finance or property rights. His teacher was nature, chance, or what you may please to call the object-lessons afforded him by caves, rocks, trees, winds, waves, etc.

The present day engineer is the heir-at-law of the builders of Karnac, the Great Wall of China, the Pyramids, the great Roman highways, aqueducts and sewers, the later temples, bridges and buildings of the middle ages, the steam-engine, the railroad, etc.

How then can we accept an apology for the vague and indefinite meaning of the word engineer on the ground of the youthfulness of the profession?

The writer prefers Parsons' definition of the new engineer—"The man of commerce, industry, business, who makes engineering a means rather than an end—the man of affairs." (The Philosophy of Engineering.)

Mr. Ockerson believes that the engineering profession must be recognized and applauded because of its usefulness to humanity, but the writer is inclined to think that if, after quietly and modestly doing the important work of the world for the last ten thousand years or so, the engineering profession has not attained any higher place in public estimation than it now occupies, it is about time to change the program.

Even a casual reading of the current technical publications will show that there is among engineers an increasing tendency to give voice, not only to the belief that the engineer is not properly appreciated by the "Man on the street," as well as by the much-exploited man of "big business," but also that engineers and their organizations do not realize that many of their troubles arise from insufficient and narrow educational methods, from their own careless use of indefinite but familiar terms, (e. g. "Going Value," Depreciation, etc.), from their indifference to the effect on the profession of the failure of structures that are improperly designed or badly constructed, and from other deficiencies that can only be corrected by engineers and through their organizations.

Without attempting to hunt up articles bearing on this question, and merely by glancing through publications lying on the writer's desk, the following may be cited:

Address of Dr. W. F. M. Goss, Past-president of the A. S.

M. E., Editorial on Excessive Self-Confidence, Engineering and Contracting Journal—Dec. 24th, 1913; Philosophy of Engineering by Parsons in the April number of Proceedings, American Society of Civil Engineers, and the discussion in later numbers; Editorial on Code of Ethics for the Engineering Profession, Engineering News—Dec. 11th, 1913, and Editorial on What is a Leveler and Why? Engineering News—Dec. 4th, 1913.

Mr. Ockerson, himself, in the closing words of his able address to the American Society at Seattle intimates that the Society is not entirely fulfilling its obligations to the profession when he says:

"It *should* fix and require such moral and professional standards that membership will *at once* be recognized as a *guarantee* of integrity, honor and ability, so that its members *may* merit and receive the fullest respect, esteem and confidence of their fellow men." The italics are the writer's.

A year later President Swain at Ottawa said, "We have been much criticised in the past as being inactive, as taking no part as a Society in large public questions. I must frankly confess that the criticism seemed to me in some measure deserved. Our Society is large, rich, influential, but we have been too content to sit down in dignified ease, taking little or no initiative, and allowing other and younger Societies to outstrip us in actual work performed and in real influence exercised. I believe that we could and should go much further in these directions; that we should step forward and take the initiative and become a moving force in the community."

The writer does not assume responsibility for the statements referred to by Mr. Ockerson, in regard to the deterioration of the quality of the papers published by the Society, nor as to the loss of prestige of the honor of membership. He has simply stated that it is a fact that this is the belief of many members. The writer thinks that the issue should be met squarely, and that whatever foundation there may be to support such beliefs among members, should be removed by the Society itself. He has suggested a Publicity Bureau, whose activities might be carried out in some such fashion as is being done by the Junior Institution of Engineers of Great Britain, and further that engineering organizations should take a prominent part in public affairs.

This is an age of advertising. No business can be successfully conducted without it. Emerson's man in the depth of the

forest, whose ability in some line would compel the world to wear a road through the wilderness to find him, has no place in the twentieth century. Hero-worship to-day can only be evoked by printers' ink. The public, great and small, are not looking for and seeking out those whom they can honor, but are reading about and believing in the men that advertise. It may be a severe strain on the dignity of the engineering profession, to stoop to use modern commercial methods as a body, but the individuals are already doing so, and the professional organizations must follow the lead or gradually become repositories of technical data, holding their memberships together by the slenderest of ties, or else be entirely supplanted by other more modern and aggressive institutions.

The writer is as much inclined to regret that the American Society of Civil Engineers is being criticised as Mr. Ockerson can be, but he realizes that the truth must be faced and believes that the trouble should be remedied if possible.

The principal difference between Mr. Ockerson and the writer is that Mr. Ockerson seems to believe that the Society is doing all that should be done for the profession and that the critic is to blame, while the writer holds the opinion that the criticisms should at least be considered, and that the Society should revise some of its methods and discard some antiquated ideas.

There are many other questions raised by Mr. Ockerson, upon which the writer would like to touch, but which must be passed over for want of time and space. After all is said, however, the main question at issue is that age-old difference in the point of view, exemplified in Ibsen's Master Builder, where the younger generation treads upon the heels of the older.

The writer must confess, in spite of Mr. Ockerson's compliments upon his "facile pen," that his skill must have been much at fault if he has left the impression that he has lost faith in the engineer, or that he is not proud to be known as one of them and honored in being a member of the American Society of Civil Engineers and of the Engineers' Club of St. Louis.

So in public and private, the writer has and does hold up the true engineer to the world as the "Foremost man in civilization to-day."

Mr. Greensfelder. I wonder how this appeals to the Mechanical Engineer! Mr. Holman, may we hear from you?

Mr. M. L. Holman. I had not intended to take any part in the discussion, but I will venture a word in defense of the "mechanical man." I would like to know why the poor fellow who is heaving coal into the fire box of a locomotive until he can hardly stand up is not entitled to be called an Engineer under our ancient definition. If he is not an Engineer under that definition, what is he? We should revise our definition. The trouble is that the word Engineer, as used in the old days,—and they had no other word,—was applied broadly.

Now a word about the licensing of the Engineer. If you will take the practice that comes through a consulting Engineer's office in the course of a year and make the Engineer apply for all the different licenses that he would require for the business, it would keep one clerk at Jefferson City all the time. It runs all the way from irrigation in Arizona to the latest gasoline engine that is going to revolutionize the world. That is the business which comes in and has to be taken.

Another thought which has been entirely overlooked in this discussion, and which I think is the cause of our trouble, is the present demand that Engineers develop along entirely new lines. I called attention to this point several years ago at a talk to the students of Washington University. There is developing a profession known as Engineering Contractors,—a firm or association of men who will take on, not only the design, but the actual execution of work and, at the present day, finance the undertaking. The work at Keokuk—this large hydraulic installation—is due solely to the ability of an Engineering Contracting firm to handle not only the construction and see that the designing and engineering are all right, but to finance it in addition. It is one of the heavy pieces of work lately executed, and one where some very good mechanical work has been done. I will not say anything about the financing, of which there has been considerable advertising. The result will appear later, I suppose, in the Congressional investigation, and some people will get a shock in a different way from what the public expects.

Take our largest piece of work, the Panama Canal. That had to be done by the Government of the United States. No Engineering Contracting firm, private or public association, of individuals could accomplish it. It had to be undertaken and driven through by the salaried employees of the United States.

So far as I can see the Engineer is going to run into one of two distinct lines of employment. He either becomes the salaried employee of some manufacturing corporation, public utility corporation, railroad, city, state, or federal government, or else he becomes the Engineering Contractor who is ready to undertake, not only the engineering and constructing, but the financing of the work.

Mr. S. Bent Russell. This discussion has certainly been most interesting and the subject is one of the greatest importance to our profession in my opinion. I feel that it ought to be discussed fully upon all sides. I believe that if engineers would take the subject up more deeply than they have in the past that they would show the capacity to solve the problem and be able to do much to improve the status of the Engineer. It has occurred to me that we should consider the problem a sociological one and try to have the broadest possible view of it. I mean we should be in the attitude of striving to change the status to one more beneficial to the public generally and not merely for the advantage of our own profession. Engineers should show their superiority to groups of men in other vocations by their subordination of self interest to the demands of the general uplift. When we had thus determined the ideal status of the engineer, we could work together in the effort towards making it a reality.

I have observed in this and similar discussions that engineers of long experience and especially men whose careers have made them prominent, are disposed to be well contented with the status of engineers and the progress that is being made by the profession. As such men are generally deferred to it is natural that to all appearances, the profession does not want improvement very earnestly. Now if a true expression of feeling and opinion from the rank and file of the engineering profession could be had, I should expect to find a majority in the insurrecto class. I mean that the majority of engineers would declare the present status of our profession to be far lower than it should be and that more vigorous effort should be made to better it than is now being done. Although they do not say much about it, that is the way they think.

Mr. Greensfelder. Mr. Philip Moore, can you tell us how it appeals to the Mining Engineer?

Mr. Philip N. Moore. As I heard the discussion, there

has occurred to me a distinction which has not been brought out by any one concerning the question of licensing engineers wherein the argument in favor is based on an analogy to the licensing of physicians. The difference between the two professions is, that the physician works for a great number of people, many of whom, presumably, would not have the means of protecting themselves against charlatanism were they not protected by the State through its Examining Boards. The Engineer, while serving the community in the larger sense, is employed by a relatively small number of people, generally men of means, presumably intelligent,—not always so,—but, as a rule. They are men who have acquaintance enough with human nature, with business, to be able to choose wisely on their own judgment. There may be cases such as those to which Mr. Wall refers, where an Engineer has the misfortune to deal with a Board of City Officials, who, whether publicly or secretly, call for competitive bids from engineers for a given task. But, after all, wherein does treatment of the engineer in that case differ from what the commercial man meets all the time—the question who will tender the best and cheapest article of service, at the least price. Understand, I am not expressing approval of this method, but engineers have no right to complain if they submit to it.

It seems to me that, after all, when a man has passed the first few years of his professional service, he settles, by force of circumstances, into his proper class—the world classifies him whether he will or no, and no Board, nor examination, nor license can more than temporarily keep him out of it. He may be unwise, his judgment may not be good, he may not realize it himself, but his next employer will know it and his next employer will not be there.

Why then, should we attempt in any such artificial way, methods which in a way smack of Trades Unionism, to demand a classification on the part of society, for engineers, which will relieve the employer of the responsibility which is rightly his,—the selecting of his employe?

Mr. Greensfelder. How does it appeal to the Electrical Engineer, Mr. Humphrey?

Mr. H. H. Humphrey. I heard Mr. Wall's paper the evening it was read, and I was very anxious then to get on my feet

and talk about it. I had a great many arguments in reply to it, but right now they have all disappeared, because they have all been covered by the other papers. I liked particularly to-night, the discussion of Mr. Moore, and I want to add to it by saying that it is my experience in the Electrical Engineering line—that a man's field is limited only by his own abilities as an Engineer, and his capacity for work. The world is wide and a man does not need to be limited by St. Louis or the State of Missouri, or the Continent of North America. He can go as far as his abilities will carry him.

I was particularly solicitous, when the paper was read, that the younger members of the profession should not take such a pessimistic view of the future as Mr. Wall outlined. Now, of course, if a man is starting out with the idea that he will be a millionaire, he is in the wrong profession and he ought to find that out very soon, and he undoubtedly will find it out very soon and get in some other line; but if he is in the Engineering Profession to make a man of himself, and not only make a living but make a life, he cannot choose a better profession. The Engineer is essentially honest, and he must maintain his reputation as an honest man, if he is going to succeed.

Mr. Greensfelder. I will be glad to hear from Mr. Brenneke.

Mr. W. G. Brenneke. The ground has been so thoroughly covered, I do not think I can add anything.

Mr. Greensfelder. We were all waiting to have the Academy put upon the stand of Engineering. Now we will hear from the defender of that, Prof. Van Ornum.

Prof. Van Ornum. I suppose if I should follow the ideas of the original writer of the paper, I should enter into as lengthy and strong an argument as it is possible to make. I prefer, however, to take my stand upon the other side of the question, and leave the defense to those who have had the experience—the young graduates themselves.

Mr. Greensfelder. Mr. Toensfeldt, do you want to assume the white man's burden.

Mr. Hans C. Toensfeldt. There is one thing that may not have come to the attention of some of the members. There is a series of articles being written by Mr. Wm. Hard, the first of

which appeared in the December, 1913, "Everybody's," in which he deals with what I might call the external influences affecting the status of the Engineers. The articles are a consideration of American business, in view of the fact that it is being drawn into competition with the business of the world, due to the doing away with the tariff law and Mr. Hard points out the necessity for better business in America. He then emphasizes that better business in America is chiefly a question of better engineering and then he attempts in the second article to analyze some of the things which tend to chill the enthusiasm of American Engineers. The first of these things he analyzes are the Patent Laws, and I think it ought to be interesting to the members to read these articles.

Mr. C. E Smith. After the high class papers presented by Mr. Wall and Col. Ockerson and the remarks of the other preceding speakers, I feel I can do little in stating the status of the Engineer on the Railroad, other than to bring you all down to earth with a great big bump..

The status of the Engineer on the Railroad has never been what I consider it should be. There is probably no other branch of engineering in which Engineers come so closely in competition with men trained along other lines than in Railroad work, and, in this competition, Engineers have, in my opinion, failed to make good in a large way.

There appears to be a lack of confidence in the ability of Engineers all along the line, starting in with the Section Foreman. Section Foreman frequently refer to the young engineers as "algebra lads" and "blue print boys" and the opinion of a section foreman or of the ordinary roadmaster of a young Engineer is not flattering. The practical man who has learned in the school of hard experience to do things, usually objects to being advised by an Engineer that there is a better way and it happens all too often, that the practical man's way is the better. This unsatisfactory opinion of Engineers is not confined to section men and roadmasters, but crops out here and there all along the line.

Experience has shown that if several men start railroading, one of whom is an engineering graduate and the others such men as telegraph operators, switchmen, brakemen, machinist appren-

tices, section foremen, etc., all of the same age, the chances are that after a period of years, even though the Engineer may attain to a satisfactory position he will frequently be subordinate to the men who started in as telegraph operators, switchmen brakemen, machinist apprentices, section foremen, etc.

There are, of course, many notable exceptions to this rule, chief among which in our neighborhood is Mr. Bush, President of the Missouri Pacific, who started in as an Engineer, but broadened out into other lines early in his career. The First Vice-President of the Missouri Pacific, Mr. Pearson, is also an Engineer, but on the other hand, Mr. Nixon, Chief Operating Officer, and recently President of the Frisco, started in as a bridge carpenter and more of the larger officials of Railroads started in as other than Engineers, than as Engineers.

I think the trouble is partly due to the fact that when an Engineer gets out of college his immediate salary, though small, is usually somewhat greater than that of other men of equal age and as he is so provided for, he does not exert himself as he should for advancement.

As a rule railroad engineers take too little interest in public matters and confine themselves strictly to their railroad work, soon getting into a rut from which it is difficult to escape.

Other than this I am unable at this time to state why Engineers on Railroads have not made good in a large way and will be glad to hear from some of the other members present as to why this condition obtains.

Mr. Mont. Schuyler. Institutions are valued by their adherents in direct proportion to that which may be gotten from them. If an institution is so dignified and proper that honors are the only things which may be abstracted from it, a person not desirous of honors would have no pride in that institution. So it is with the American Society of Civil Engineers, in which Mr. Ockerson finds much to be proud of because it has given him honors, he already having many of the fruits of a conscientious and active life. In the case of the younger engineer honors are of small moment. His particular concern is with opportunity and its chance for advancement and better employment. He normally would have more pride in an organization which would give him the greatest help in securing employment

in lines of work in which he is interested, than in one which had only—to him—empty dignity to give. It may be possible, and I believe it is, to combine dignity and job hunting. Mr. Wall has just quoted Ibsen to the effect that "the young are forever treading on the heels of the old," but perhaps it would be better to put in that the young walk in paths which the old have traversed and abandoned for other routes. But being young, youth demands opportunity to test his strength and show his power, and every agency which expands his horizon should be available to him. Since the young engineer is a large factor, numerically at least, in the American Society of Civil Engineers, his especial needs should be considered as thoroughly as those of his older co-worker. The paramount need of the young is reputation in some form and this end, while attainable through papers and discussion, could be better reached through an employment and publicity bureau which might not only make known to others his qualifications but also acquaint him with opportunities which may develop in remote communities.

Mr. Edward E. Wall. It has been mentioned by several of the speakers here that if a man's only object in the world was to acquire wealth, then some of my contentions would be correct. Now I am not at all in sympathy with the idea that it is the wrong motive to want to acquire wealth. Wealth is really the American standard of fame. The men who affect to despise wealth are actuated by the universal human propensity to belittle other men's possessions and to over-value their own. They desire to set up a standard of excellence which they believe they have reached, or that they can more easily attain. I have not personally known any man that objected to the legitimate acquisition of wealth for himself.

Mr. Greensfelder. Col. Ockerson, do you wish to close?

Mr. J. A. Ockerson. Mr. President, I am glad that I did not allow Mr. Wall's paper to disappear. It was delivered here on the 17th of September and everything was so quiet that I concluded it was a good subject to put more life into and give everybody a chance to drive at it, and get their views about it, and that was what induced me to write the few remarks that I did, and inasmuch as I did that I feel, Mr. President, that that has precipitated others to come to the front with their views and has made the discussion a very interesting one.

I want to say about that classic on river improvement that I think I own that volume, which is perhaps the only volume on that subject in the United States, and if any of you gentlemen want to see it, I will be glad to show it to you.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, by March 15, 1914, for publication in a subsequent number of the JOURNAL.]

RECENT ECONOMIES IN THE SUGAR INDUSTRY.

By Alfred L. Webre, Member Louisiana Society of Engineers.

[Read before the Society, Oct. 6, 1913.]

Now, that the Sugar Tariff Bill has gone through, we who are engaged in the sugar business are naturally planning means to meet the new conditions. We must admit that we have a strenuous task ahead of us, but as Dr. Alderman used to say, "God Almighty hates a quitter," we are not yet ready to quit.

The task is strenuous for many reasons. The planters have had a succession of three bad years with early freezes, crevasses and other mishaps, their financial resources are depleted and they are discouraged. The new conditions imposed require that we produce sugar cheaper. This can be done in two ways: first, by producing cane cheaper, and producing a better quality of cane, having a larger percentage of sucrose, and one which will withstand cold weather with more hardihood, this is in the province of agriculture.

The other means of obtaining our end is to cheapen the cost of manufacture, at the same time, obtaining maximum results in the recovery of the sugar contained in the cane.

We will discuss to-night only one phase of this situation; namely, steam economy, how it can be obtained, and what results it will bring about.

Steam in a sugar factory is used for various purposes; in the first place, it supplies the energy to operate the machinery, including engines and pumps. This is only a small proportion of the whole, being about 12 to 15 per cent including the radiation losses.

Steam is also used to heat the juices of the factory from about 60° to 212° F.

It is also used in the Multiple Effects, and lastly in the Vacuum Pans.

Inasmuch as the amount of energy taken up for power purposes is so small, as compared with the total amount consumed. an improvement in the aforesaid power apparatus, could bring

about only very small economies, which would hardly justify the investment.

We refer to making the engines compound condensing instead of simple, or of using Diesel Motors to run the mills, which has been suggested, or of generating electrical energy with turbines, or other highly economical power apparatus, and then using this energy to operate pumps, and other small power consuming machines.

We do not mean to state that the use of electrical energy in the factory is not desirable or convenient for many purposes, but we do mean to state that practically the only saving will be in slightly reduced radiation losses. For instance, the steam used in a compound condensing engine is not available for evaporation purposes. In this case there would be an actual loss of heat, for this steam has only given up a part of its mechanical energy, which is in turn only a part of its total energy, throwing all the remainder to be killed in the condenser. Far better results would have been accomplished if this steam had been available for use in the effects, where it would serve—"in multiple."

The proposition is this: We are primarily concerned with ing for granted that the present day furnaces burning bagasse heat economy, not power economy, as we will show later. Takgive good results, we must turn to the heating and evaporating apparatus.

The present Louisiana practice in this regard is not up to the work being done in Europe and other countries. There is only one Louisiana House having vapor heaters in successful operation. There are only two houses equipped with quadruple effects, although there are a great many triples. The majority, however, have plain doubles and quite a number have no effects at all, using open evaporation throughout.

Perhaps this is due to the fact that our financial condition has not enabled us to spend the money for the improved equipment, but to our way of thinking, it is mostly due to the fact that we have fallen into a rut. The altered conditions about us will not enable us to live as we are; therefore, it is incumbent upon us to make some change with a view of improvement.

The recent developments in the European methods have been as follows: It has always been our dream to use the vapor which was thrown into the condensers to heat our juices. Ril-

lieux, to whom is generally assigned the credit of originating the multiple effect, advised it on the basis that whatever work was done with this heat, was a clear gain. But the temperatures of these vapors were so low, as to make the available gain unworthy of serious consideration. Such being the case, the Europeans did the next best thing. Instead of using vapors from the last effect, they robbed the preceding ones, as the occasion permitted. They increased the back pressure on the exhaust lines of the house, and also reduced the vacuum, thereby raising the boiling temperatures, making the vapors more useful.

It must be remembered that the heating done with vapors of the last body of a quadruple costs nothing; also the heating done with vapors from the third body costs one-fourth as much as if it had been done with live or exhaust steam; the heating done with vapors from the second, one-third; that done with those of the first, one-half. But since the temperatures of the third and fourth bodies were so low as to limit their usefulness, it was decided not to use them, and to rob only the first and second bodies, not only for heating juices, but also for boiling vapor vacuum pans. They then arranged the heating surface in each cell according to the amount of evaporation it must accomplish.

They also found that when a quadruple was thus operated, there was not enough exhaust to do the work, but it paid better to put live steam in the first body than in the pans and heaters, as each pound of steam used in this way did several times as much work as by the old methods.

They went even further. Instead of putting live at 100-pound pressure in the first steam belt, where the pressure is only eight pounds, they put it in a pre-evaporator called a "Pauly" after its originator, and boiled the juices before reaching the effect under eight-pound pressure, mixing the vapors from the said "Pauly" with the exhaust in the first steam belt. In this way, every pound of live steam supplied evaporated a pound of water from the juice before being used in the effect, which netted a substantial gain. Furthermore, when the juice left the "Pauly," to go to the first body, it entered the effect above instead of below the boiling point, this made the work a great deal easier, as the surface in this cell was used for evaporating only, instead of heating and evaporating.

They found that an apparatus, as described above, did from 25 to 30 per cent more work than a plain quadruple with the

same steam. This was great progress. The vacuum in the last effect was not allowed to exceed 24 inches. This required less condensing water, less pumps, and gave good scatisfaction. It was simply a more intense application of the principle of the use of steam in Multiple.

However, there is always room for improvement. Inasmuch as the third and fourth body operating on vapors from the preceding units after these had been robbed for the heaters and the pans, could only do very little work, the question of their elimination has come up. Theoretically, this would seem the logical thing to do. There have been several applications of this arrangement in Europe. The condenser has been eliminated altogether, and the last body operated *atmospheric*. The only apparatus, however, which has been able to accomplish this result under limited conditions is the Kestner Effect. This has been possible because of the high efficiency of its heating surface, as compared with the ordinary apparatus.

The difficulty of attaining this end is due to the following cause: It is not practical to carry more than 10 to 12-pound pressure on the exhaust lines of the house, as it impairs the operation of the engines and pumps. The temperatures, which correspond to the above, are 240° and 244° F. respectively. The temperature of steam at atmospheric is 212° F. The total available drop is, therefore, 28 to 32°. For a double effect, this would be divided into two, being 14° and 16° respectively, which with the ordinary standard effect would give a very slow rate of evaporation, for it must be remembered that not all of this temperature fall is available for useful work.

For instance, the boiling temperature of syrup at 50 Brix at atmospheric is 216° F. Since the vapors leave the syrup at 212°, there is evidently a loss of 4°, in a similar manner the loss of temperature in the first body is 1½°. This is not all, there are other losses, which we will discuss later, bringing the total to about 10°, which when subtracted from one 28° and 32° leaves 18° and 22 respectively, and when this is divided between the two bodies, it gives a useful drop of 9° and 11°. This is not sufficient for practical results with the every day apparatus.

We have had the good fortune of developing a new type of evaporator, which has actually shown in practice an evaporation of 12 to 14-pounds per square foot per hour with a useful drop

of only 8°. This makes the operation of the atmospheric double perfectly feasible, without any difficulty.

Only two objections can be raised to this arrangement: First the radiation losses in view of the high temperatures may be somewhat greater, but by properly covering all heated parts with a good layer of magnesia or asbestos, these losses can be maintained to negligible proportions. The other objection is the supposed danger of lowering the co-efficient of purity at high temperatures.

We are advised, however, by no less an authority than Karl Abraham, one of the foremost sugar experts of Europe, that as long as the boiling temperature does not exceed 240° F., there is no injury to the sucrose contained in boiling solutions.

The advantages which are evident at a glance are as follows:

1. With an atmospheric effect, there is no injection water required for the condenser. The water supply is always a troublesome and costly proposition involving the outlay, upkeep and operation of complicated system of pumps, canals, piping, cooling towers and what goes with them. If, for no other reason, the change to this system would be justifiable.

2. There are no vacuum and sweet water pumps required, nor the steam exhaust, and vacuum piping for same. The condensation in each calandria is forced out through the drain pipes under pressure, and gives good boiler feed at or above the boiling point, and in quantities sufficient not only for the boilers, but also for washing out and other purposes.

3. The tube sheets, tubes, vapor belts, domes and piping are all made of copper, designed to withstand a bursting pressure of 5 pounds, which is much easier to hold than a corresponding vacuum involving collapsing pressures. These can, therefore, be made relatively light. We have, then, copper contact for our juices during the entire process of evaporation, and there can be no decoloring action due to contact with iron, which is the case with the standard effect.

4. Inasmuch as the boiling temperature of the second body is 216° F., the syrup will settle very rapidly and thoroughly, giving a good, clear product for the pans without reheating, at the expense of live steam. This makes a vast difference in the quality of the molasses, the price of which is greatly affected by its appearance.

5. The last body has a vapor pipe leading to the atmosphere

with a special low pressure relief valve. The vapors leaving this body are used for two purposes; first, they heat the entire juices of the house up to 200° F., this leaves about two-thirds uncondensed. These are led through a vapor pipe to a properly designed calandria pan intended to operate with steam at 212° F. The live steam supplied goes first through a Pauly. Fig. 1.

With this equipment, it is possible to operate a 1,000 ton Louisiana House on approximately 1,000 horse power. The

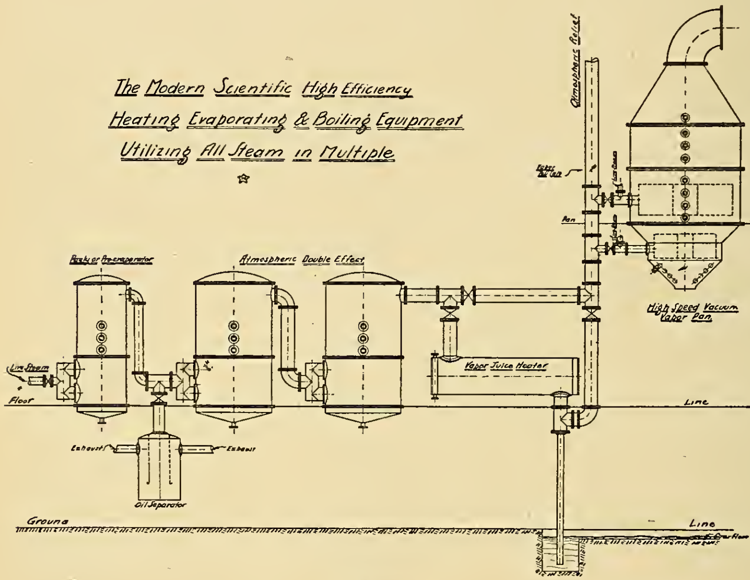


Figure 1.

significance of this statement will be readily understood when it is remembered that an ordinary double effect house uses 1,825 h. p., a triple effect house 1,480, and a quadruple, 1,300.

Inasmuch as at times some Louisiana Houses with triples are self-running, but not self-starting, as far as fuel is concerned, we are led to the conclusion that a house equipped with an atmospheric double, a vapor heater and a vapor pan will operate on bagasse alone continuously and have fuel to spare.

The apparatus required is not excessive in cost and preliminary estimates would indicate that the fuel saved during one season's run would pay for them. This is even leaving out of account the better prices obtainable in view of improved products. The above is, of course, of paramount interest to those who

own and operate sugar factories. It will, doubtless, be of more interest to your Society, however, to review briefly the basic principles of evaporation and particularly of the apparatus we have just spoken of. Fig. 2.

The operation of an Evaporator is very similar to that of a surface condenser. The only difference is that instead of condensing steam by means of water at a cooler temperature, we are condensing it by means of a liquid on the other side of the heat-

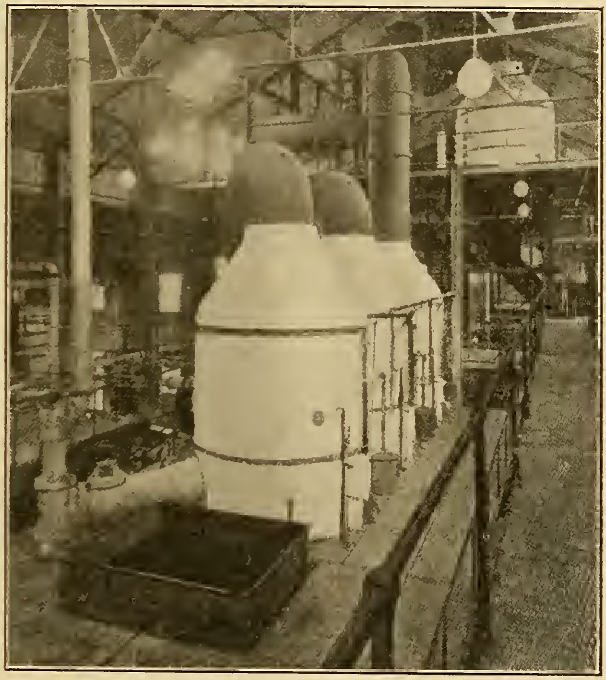


Figure 2.

ing surface boiling at a lower temperature than that of the steam being condensed. There are, of course, a mass of details to look after, which do not exist in the condenser. The heat transfer takes place due to the difference in temperatures of steam in intimate contact with surface on one side, and that of the juice also in intimate contact on the other side.

One of the problems that puzzled the earliest experiments remained unsolved until recently is the difficulty of completely

purging the heating surface of air and other non-condensible gases as fast as they accumulate. As will be seen by Fig. 3, our arrangement consist of a series of concentric baffle plates inserted between the tubes on the steam side providing a twin

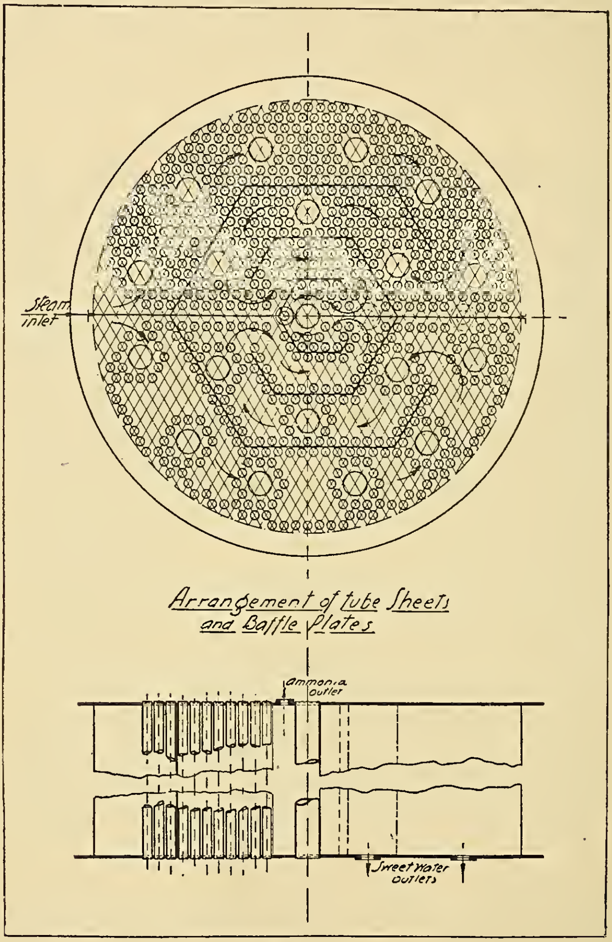


Figure 3.

continuous path of progressively reducing cross-section within the heating surface, through which the heating medium is made to travel at a relatively high velocity, driving all the non-condensible gases to one point from which they are taken out. This not only drives the body of dead gases towards the outlet, but

exposes the tubes to a scouring blast of steam currents, which removes the insulating airfilm from the surface as fast as it is formed.

The foul gases are taken out of the calandria by a pipe connected to a header leading to the condenser. The connection to each calandria is equipped with a detector, which is a device for indicating the correct opening of the valve in the connection from the steam belt to the header. This consists of merely observing the temperatures of the outcoming mixture, and by reference to the corresponding vacuum temperature, the air pressure at the end of the path is indicated. We generally aim at keeping this air pressure not over 1 in. of mercury. This influence is naturally much more detrimental under high vacuums than otherwise on account of the distended condition of the air or insulating gas, as the case may be. One must also remember that whatever air is discharged from the heating surface is accompanied with a large percentage of vapors. For instance, in the last of a quadruple operating under standard vacuum conditions, namely 19 in. in the steam belt, 1 in. air pressure would indicate that we were discharging ten volumes of steam to every volume of air according to Dalton's Law of Mixed Gases. Naturally, there is only a very small volume of air to remove as compared with the original volume of steam. This results in a heat loss, which, however, can amount to but very little as the air pipe leading from the steam belt of a 10 ft. body is only 2 in. and the valve is never wide open. The volume of vapors going into this last body from the preceding one is 600 cu. ft. per second. The amount of heat which can be discharged through this pipe into a higher vacuum, say 26 in. is relatively very small.

However, the retarding effect on the heating surface is marked. Professor Kerr, in his recent tests at the Louisiana State University found that an air pressure of even 1 in. in the steam belt when this was under 12 in. vacuum, cut down the rate of evaporation 27 per cent. His experiments, however, were made in a "standard" effect, in which no air concentration was attempted, so that the entire belt was affected by the presence of the 1 in. air pressure. In our case, however, this pressure becomes concentrated only at the end of the path, so that even if we have 1 in. air pressure at the outlet, it does not by any means follow, that this pressure exists throughout the surface; in fact, we estimate with proper operation only about 10 per cent of the

heating surface is materially affected, as will be readily understood by referring to the illustration. This enables us to maintain a relatively low air pressure, with very little waste of steam, resulting in very high rates of heat transmission; in fact, we believe they are the highest on record for evaporating apparatus. This high efficiency then comes from two sources; first the practically complete elimination of foul gases from the heating surface, and second, the scouring of the air film on the tubes due

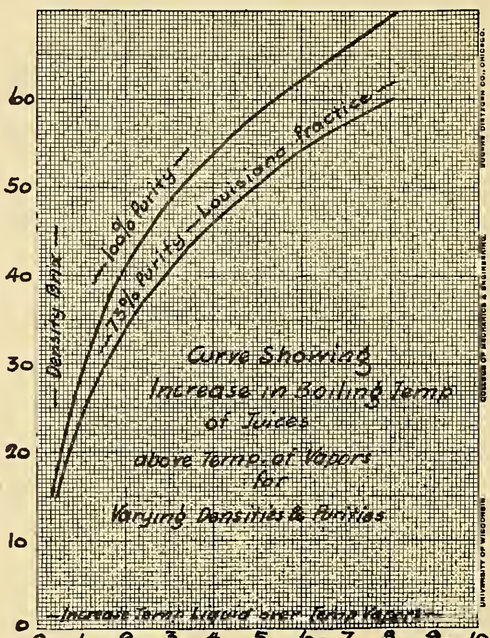


Figure 4.

to the high velocity of the steam around them. This was obtained by making the cross section of the path such that at any point it remained approximately proportional to the volume of the uncondensed steam. It is, doubtless, also materially assisted by the complete drainage of the water of condensation, thereby minimizing the insulating effect.

The above discussion is just as applicable to surface condensers. Let us now consider the difficulties encountered on the juice side of the tube.

There are several causes that tend to retard the operation of

the Multiple Effect; for instance, the density and viscosity of the liquid being evaporated; foul heating surface, too small vapor pipes, and the static head loss. Let us discuss these in detail.

The viscosity loss may be divided into two parts; first, the loss due to the difference between the temperature of the boiling juice, and that of the vapors leaving it. This is clearly shown in the curve accompanying Fig. 4. It will be noted that this difference increases with the density of the liquid. It will also be noted that it is greater with impure juices. Many a sugar boiler can testify to this, when he has to cook strikes on a vacuum pan, when the cane has been frozen, and its purity reduced materially. The difference in temperature simply cuts down the available drop and reduces the capacity of the evaporator in proportion. This can be accurately determined with properly calibrated thermometers and gauges.

Aside from this, the increase in the density, doubtless, has a further retarding influence in that the liquid being boiled acquires such a large percentage of solid matter, which actually insulates the surface from the water particles. It is almost impossible to accurately determine the extent of this phenomenon, and we are, therefore, compelled to make an approximation by the elimination process, which from experiments we have conducted shows the loss to be about equal to the boiling temperature losses. The most logical way to minimize it is by rapid circulation.

Foul heating surfaces also retard evaporation. This fouling comes from the solids contained in the juice, which are precipitated upon concentration. To obviate this difficulty, some have resorted to filtering the syrup as it is transferred from one body to the next. This is, doubtless, good practice, though it involves complications. It was found by experiments conducted last season on a Swenson Quadruple operating in a cane house, that if the effect was cleaned on Sunday, by the following Saturday, it would be only 50 per cent effective. With fast circulation, however, this trouble is materially reduced. With the rapid rate of evaporation in our apparatus we have experienced little or no difficulty from this source.

Small vapor pipes have been the cause of considerable inefficiency, not so much in American as in European apparatus of old manufacture. Velocities should not exceed 150 feet per second, and a standard of 100 ft, is preferable, for it must be

remembered that loss of pressure due to friction varies with the square of the velocity. We have learned our lesson, and we know just what to expect, our losses from this source on a triple amounted to a total of about 6 in. of water, which is about 1½ per cent, and is quite permissible.

The heat transference is also affected by the velocity of the juice and vapor travelling through the tube. Fig. 5. This increase is probably due to a rapid brushing off of the microscopic bubbles on the surface as they are formed, thereby reducing their insulating effect. We submit a curve taken from one of our evaporators, which shows this very clearly. This apparatus was operated atmospheric, being a single body without condenser,

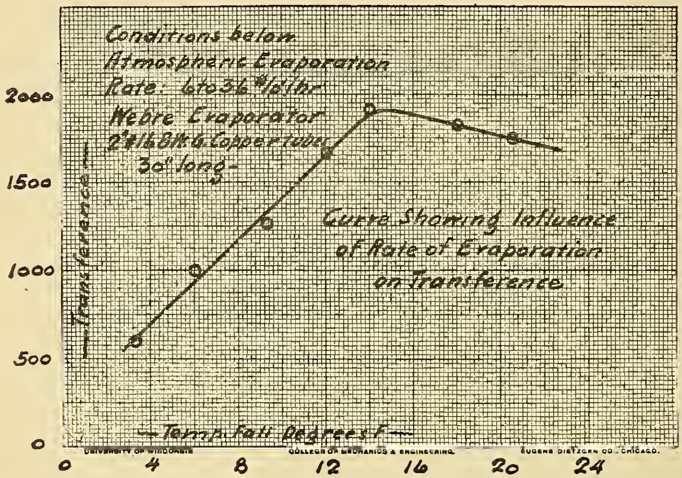


Figure 5.

the liquid used was pure water. You will note that there seems to be a peak to the curve. This is explained by the fact that after we pass a certain point, the effect has reached a maximum, from which it recedes due to the excessive friction caused by the intensely rapid flow of vapor and water at the upper end of the tube. In other words, after the evaporation exceeds 30 pounds per sq ft. per hour, an increase in the temperature head is not followed by a corresponding increase in the amount of evaporation. The maximum transference obtained was 1,910 B. t. u. per sq. ft. per hour per degree F., of course, this is under pressure. In practice, however, we are not called upon to exceed 10 to 15 pounds so that the expected rate of transference with water

would be 1,200 to 1,500. This would materially decrease with vacuum, and also with increased density.

We now come to the discussion of a most interesting problem, namely, the reduction of transference due to static head. We mean by this a loss of temperature fall due to the pressure exerted by the liquid in the tube on its lower part. Fig. 6. For instance, assuming that we were boiling water slowly under a

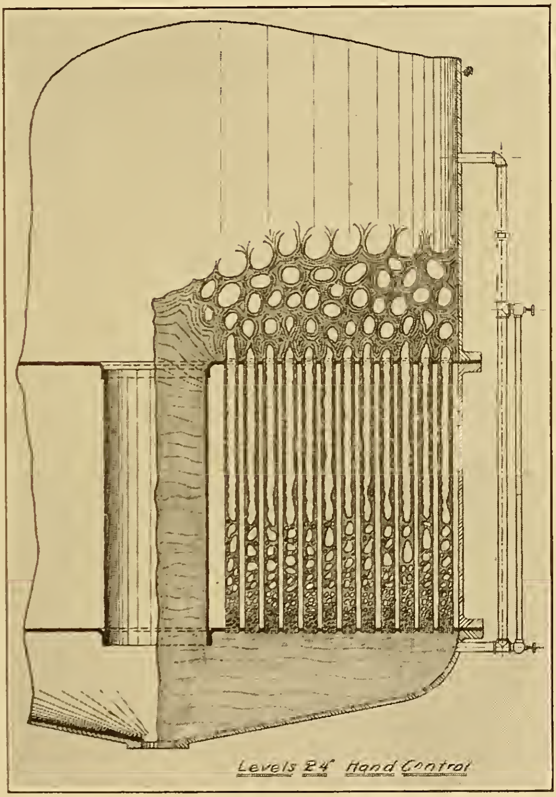


Figure 6.

vacuum of 27 in., and that the liquid were flush with the top of the tubes (assuming these to be four feet long). The average temperature of the boiling liquid would be that due to the pressure corresponding to the vacuum plus the pressure due to an average head of two feet, which would lower the average vacuum in the tube by 1.71 in. making it 25.29, which corresponds to 131.4. The temperature corresponding to 27 in. is

115°. The loss would then be 16.4°. This is still further increased when it is remembered that the density of the syrup in the last body is 50 Brix or 1.23 specific gravity, making the loss about 20°. On the other hand, if the level were carried (Fig. 7) at the proper point, which is about 8 in., the average vacuum

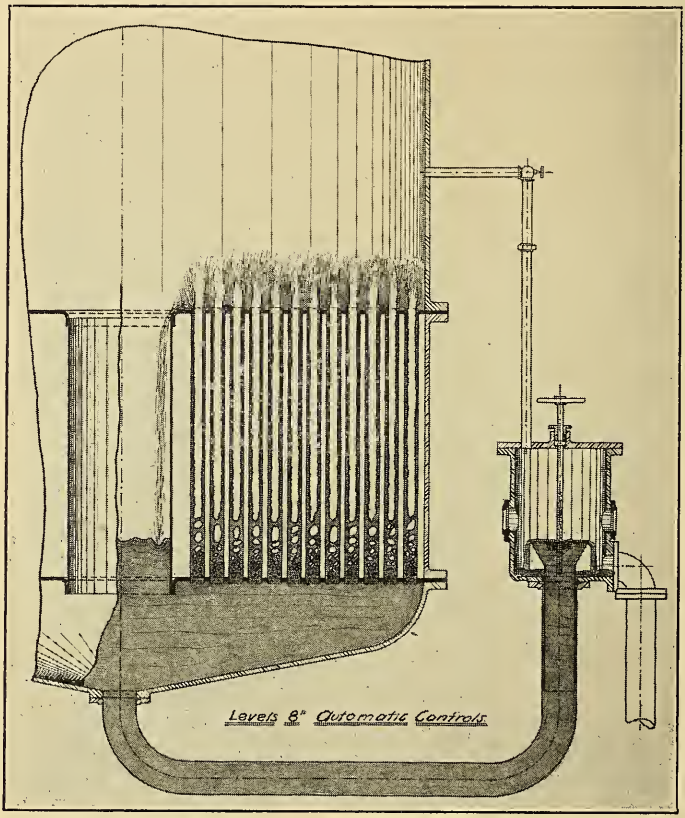


Figure 7.

in the tube would be 26.7 in., making the loss only about 3.4°. This is altogether theoretical.

In practice, the actual loss is between two and three times as great as the theoretical loss. We submit two curves (Fig. 8 and Fig. 9), one platted from a standard effect, and the other from one of our Evaporators. Observations in both cases by Professor Kerr. It will be noted by comparing the two that the losses are greater on the apparatus having the highest rate of heat

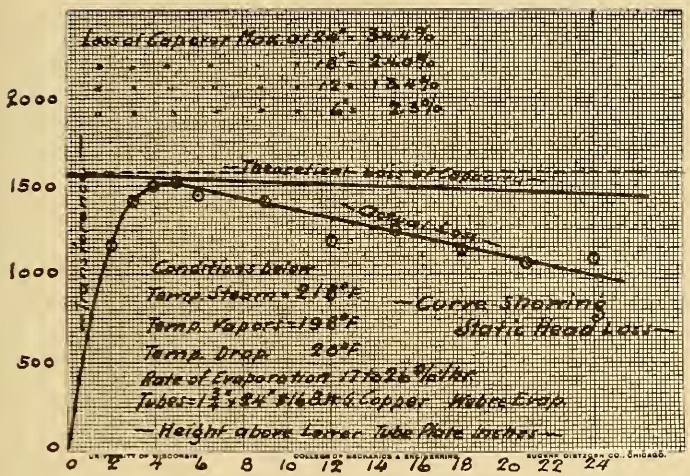


Figure 8.

transfer. This seems to confirm the data given on the curve showing the effect of rate of evaporation.

It is worthy of note that the experiments show that an apparatus carrying levels flush with the top tube sheet is retarded to the extent of 34 per cent. This has been confirmed by recent European experimenters. Since it is so important to maintain the correct levels, we have devised automatic level controllers as shown in the illustration. The essential feature of this ap-

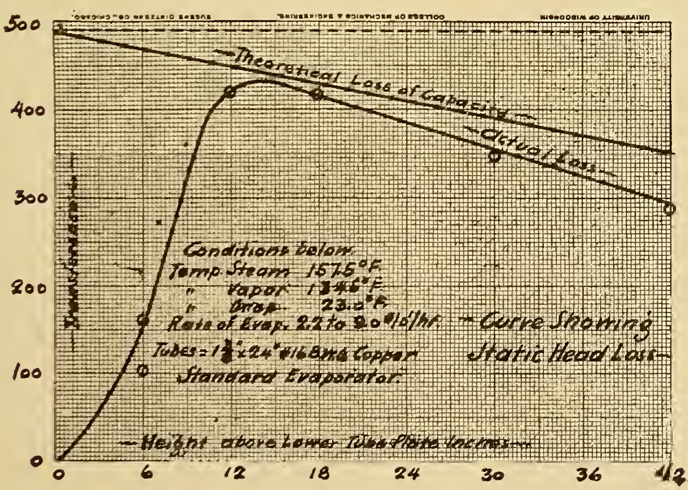
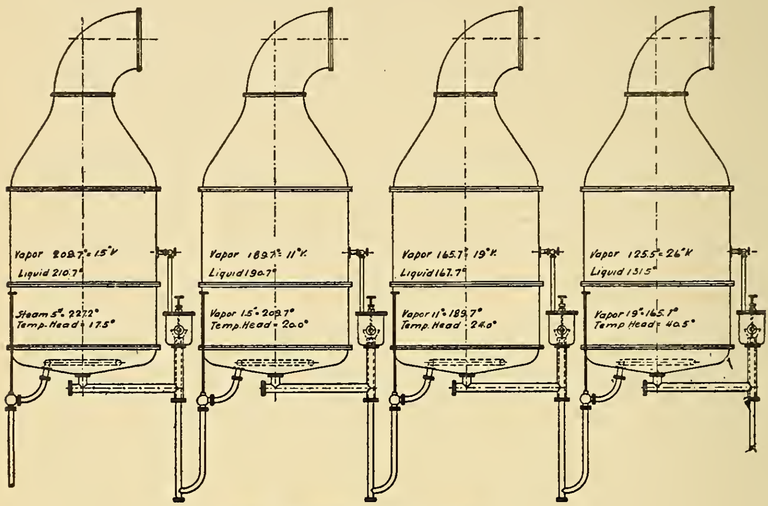


Figure 9.

paratus is its simplicity. There are no floats, it works simply by gravity, and can be cut out by closing the equalizing valves, enabling the operator to feed by hand, if this is desired. Fig. 10.

We submit for your consideration the estimated temperature distribution for a quadruple effect, showing where the losses take place, and from what causes. This is purely theoretical,



Webre Automatic Level Controls
Applied to Quadruple Effect
Figure 10.

though it corresponds very closely with present practice, and is as follows:

QUADRUPLE EFFECT.

Bodies		1	2	3	4
Boiling Temp. loss		1.0	1.0	2.0	6.0
Static Head loss		1.0	1.5	2.0	7.0
Viscosity Loss		.5	1.0	2.0	8.0
Working head		15.0	16.5	18.0	19.5
Total Head		17.5	20.0	24.0	40.5
Temp.	227.2	209.7	189.7	165.7	125.2
Pressures and Vacua	5 lbs.	1.5″	11″	19″	26″

We also submit readings taken from a 9 ft. 0 in. Triple Effect of our design showing its performance. You will note that in this instance we utilized the low part of the temperature range, as there are no vapor heaters or vapor pans. As explained before

our intention is to use the High temperatures in the atmospheric effect.

Date.	11-20-12	11-21-12	11-22-12
Vacuum steam belt 1st. effect	15.5	16.1	16.4
Vacuum vapor belt 1st effect	16.8	17.5	17.8
Vacuum vapor belt 2nd effect	20.4	20.8	20.7
Vacuum vapor belt 3rd. effect	26.4	26.4	26.2
Beaume Juice	5.0	5.0	5.2
Brix Juice	8.9	8.9	9.2
Beaume Syrup	28.3	27.8	27.5
Brix Syrup	51.1	50.2	49.6
% Evaporation by Volume	85.3	84.9	83.0
Gallons juice per hour	9120	8490	7980
Gallons juice per 24 hours	218,800	203,700	179,200
Lbs. per square ft. per hour	8.79	8.15	7.49

NOTE—The above shows working conditions at factory. The juice handled was all that was available. Evaporator was not operating half capacity.

It is worthy of note that the temperature fall in the first body is only 4°, and in the second, 12, even under the high vacuum conditions existing. The transference in the first body is, therefore, in the neighborhood of 2,000. These readings, however, were made by the operators of the machine and are subject to slight variation. However, we were present when some of them were made, and checked them as correct. Fig. 1.

Turning back to the atmospheric effect, we have built five such outfits, exclusive of Pan and Pauly, this season, all of which will be in operation within the next few weeks, at which time we will see whether or not practice will approve what theory has devised.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, by March 15, 1914, for publication in a subsequent number of the JOURNAL.]

RAILROADING SIXTY YEARS AGO.

By C. D. Purdon,* Member Engineers' Club of St. Louis.

[Read before the Society, November 5, 1913.]

In the middle of the last century, the people of this country being anxious to have railway communication from the Atlantic to the Pacific, a number of engineers of the U. S. Army were detailed to make explorations, this work occupying several years. In 1855 the Hon. Jefferson Davis, Secretary of War, reported to the Senate the result of these explorations. This report was printed in thirteen large volumes as "Executive Document No. 78; Second Session, Thirty-third Congress." The report is very complete and contains many illustrations, giving full details of plants, trees, animals, buds and fishes found; also descriptions of the different tribes of Indians met with, their habits, customs and languages. While it is now ancient history, a few extracts from the purely engineering features, compared with present practice, may prove interesting.

One part of the report, "Memoranda on Railways," is addressed to Hon. Jefferson Davis, Secretary of War, by Geo. B. McClellan, Lieut. of Engineers and Brevet, Captain of the U. S. Army and contains the following:

Gradients.

"The following gradients are now, or have been in use on American Railways:

"During the construction of the Baltimore & Ohio Railroad, a gradient of 528 feet (to the mile) was used on a temporary track "en boyan," merely to transport small loads of iron, etc.

"On the Virginia Central, the trains pass every day over a gradient of 275 feet, length 2 miles. On a part of this are curves of 300 feet radius (19° .06') on a grade of 238 feet; 40 tons have been carried up this by a 30 ton engine on six drivers with the utmost ease.

"Brakes of a peculiar construction are used, and found to answer well. On the Virginia Central the trains ascend at a velocity of about seven miles per hour, and descend at an average velocity of four miles; in descending the steam is cut off

*Chief Engineer, St. Louis Southwestern Railway.

and the wheels of the engine allowed to revolve, the brakes on the cars being "hard down." Reversed curves are frequent and sharp. On the Baltimore & Ohio are grades of 116 feet (to the mile) for 17 miles; auxiliary power is here employed, the trains being divided and running up at the rate of 15 miles an hour. The trains descend these grades with a velocity of 25 miles per hour, under perfect control.

"On the Pennsylvania Central Road there are gradients of 95 feet for 9¾ miles; where curves occur the grade is reduced at the rate of 0.025 feet per 100 feet per degree of curvature. (I might say the practice now is to go a little higher than that, 35 or 40.) Passenger trains ascend this grade with a velocity of 24 miles per hour, and descend at 20 miles per hour. The ascent, when there are more than three cars, is effected by the aid of an additional engine. The working load of the heavy freight engines (weighing 65,000 lbs. and on 8 drivers) on the 95 foot gradient is 125 tons net, or about 250 tons including engine and cars. Over the 53 foot grades on this road (Pennsylvania Central) the general load of the engines, (55,000 lbs. on 6 drivers) is 150 tons net or about 250 tons including engine and cars.

"On the Massachusetts Western Road are grades of 83 feet for 1½ miles. Engines of 20 tons draw 100 tons over this grade. Passenger trains run up at about 18 miles per hour without auxiliary power. The average amount of wood consumed and cost of haulage on the *whole* road is no greater than upon other Massachusetts Roads of lighter grades.

"It is the opinion of many able Railway Engineers that, on a permanent track, grades of 200 feet, and even of 250 feet, may be advantageously overcome by locomotive power: it being clearly understood that such grades are to be resorted to only in cases of absolute necessity, economy in working the road rendering low gradients very desirable.

"The accompanying formulae, and their application, show what work is to be expected from any given engine over given grades, and make the loss of economy in any particular case a question of easy solution. It is evidently the fact that there is at present a strong tendency to use much higher grades than were formerly considered practicable or advisable. Even in England and on the "Continent" the American system of cheap roads, with high grades, to avoid the great expense of long tunnels.

deep cuts and high embankments, appears to be, to a certain extent, rapidly rising in repute.

"The use of *inclined planes* with *stationary power* (within the limits before mentioned) may, as a general rule, be considered obsolete, except in cases similar to that of the Pennsylvania Central Road, where the amount of traffic is becoming so great as to require more than a double or even triple track; in this case it has been proposed to pass the *surplus freight* over the mountains by means of stationary power, reserving the locomotive power for passengers and freight requiring rapid transportation. *Planes for stationary power* should not exceed one mile in length; the number required to overcome any given ascent will depend more on the elevation to be surmounted than the length of the *ascent.* The opinion has been expressed by one of the most reliable Railway Engineers in the Country, that when the gradient does not exceed 132 feet per mile, locomotive is cheaper than stationary power, without reference to the element of first cost of grading for the two plans of operating the road; also that the difficulty and danger in descending grades is more important in determining their inclination than the resistance in their ascent.

"In estimating the loss of economy of power in overcoming high gradients, comparison should be made between the loads. *habitually* drawn over the *more favorable* portions of the road and the *maximum* load that *can be* drawn over the gradient in question.

Formulae.

"To obtain the maximum load due any engine of given weight, upon a given grade, and to obtain the maximum grade up which an engine of given weight can draw a given load.

$$\left.\begin{array}{ll}(1) & x = \dfrac{0.2\ A}{0.4242\ f + 8} \\[2ex] (2) & f = \dfrac{0.2\ A - 8\ x}{0.4242\ x}\end{array}\right\}\text{the engine and rail being in good order.}$$

$$\left.\begin{array}{ll}(3) & x = \dfrac{0.143\ A}{0.4242\ f + 8} \\[2ex] (4) & f = \dfrac{0.143\ A}{0.4242\ x}\end{array}\right\}\text{the rail being in bad order, slippery, greasy, etc.}$$

"In these formulae "A" represents the adhesive weight of the engine; that is to say, the portion of the weight of the

engine actually supported by the drivers; it is expressed in pounds. In engines with 4 drivers 0.6 of the whole weight of the engine rests upon the drivers. Sometimes as high as 0.67; 0.64 may be taken as an average; with 6 drivers the whole weight of the engine will rest upon them, and consequently be the values of "A."

"f" is the grade in feet per mile.

"x" is the load drawn, including tender, and is expressed in tons.

Formulae 2 and 4 are simply deductions by transposition from 1 and 3.

"In formulae 1 and 3 the numerator expresses the effective adhesive weight; that is to say, it expresses the portion of the total adhesive weight which is found by experiment to be really effective in drawing a load in certain states of the rail.

"Now, since we know by experiment, that on a level a force of 8 lbs. is necessary to draw one ton, if we divide the effective adhesive weight (expressed in pounds) by 8, the quotient will be the load due that effective adhesive weight, and formula 1 will read $x = \frac{0.2\ A}{8}$

"On a grade we know that, in addition to the force necessary to overcome the friction, it is also necessary to apply further power to counteract the effect of gravity. Taking a load of one ton, and calling "f" the height of the plane, "Z" the *length* (for the value of which we may, in the slight inclinations for railway grades, substitute the value of the *base* of the plane without appreciable error) we have, for the tendency of one ton to move down the plane $\frac{2240 \times f}{Z}$, or substituting for "Z", 5280, the number of feet in a mile, $\frac{2240 \times f}{5280} = 0.4242\ f$, f being the height of a plane whose base is one mile long. This expression (0.4242 f) is, then, the measure of the force required to prevent one ton from sliding down the plane, and must be added to the force necessary to overcome the friction of a ton on a level in order to obtain the force required to keep one ton in motion up a grade. Dividing then by this sum ($0.4242\ f + 8$), the disposal power of the engine (0.2 A), we have the number of tons that the engine can draw up any given grade.

(I think the calculation seems to be pretty close to present practice, except now it is a great deal finer, making a difference in whether the cars are loaded or empty.)

"Engines usually weigh from 20 to 24 tons; some as much as 30 tons; it is considered desirable to reduce the weight of engines as much as possible, in order to diminish the wear and tear of the rails.

"Most engines now run with 4 drivers, the front of the engine resting upon a truck with 8 small wheels, some engines, particularly those intended for heavy grades, are placed upon 6 wheels, all drivers, in order to increase the effective adhesive weight.

"The objection to multiplying the number of drivers consists in the increased number of joints, etc., with the consequent increase of friction and loss of power.

A common 8 wheel tender weighs, empty	14,000 lbs.
Water for 25 miles (1200 gals. at 8.35 lbs. per gal.)	10,437 lbs.
Wood (1.44 cords at 3180 lbs. per cord)	4,579 lbs.
4 passenger cars for 50 passengers at 12,000 lbs. each	48,000 lbs.
2 baggage cars at 16,000 lbs. each	32,000 lbs.
200 passengers at 150 lbs. each	30,000 lbs.
Baggage at 100 lbs. per passenger	20,000 lbs.
Add for contingencies	12,224 lbs.
Total weight of train of 200 passengers	171,240 lbs.
	or 76 tons.

"We will now take a 20 ton engine on 4 drivers and apply the formulae:

"The total adhesive weight will be about 28,600 lbs. Its maximum load on a level over a good track, 715 tons. Its maximum load on a level over a track in bad condition, 511 tons.

"By formula 2 we have, for the same engine, the maximum grade up which it can draw the train of 200 passengers as given in detail above, 159¾ ft.

"By formula 4 we have for the same data a maximum grade of 109 feet."

* * * * * * * *

"Here follow a number of calculations as to the loads that

can be drawn up grades of 150 and 200 feet, the engines given being:

20 ton engine on 6 drivers,—adhesive weight 44,800 lbs.
22 ton engine on 4 drivers,—adhesive weight 31.500 lbs.
22 ton engine on 6 drivers,—adhesive weight 49,280 lbs.
24 ton engine on 4 drivers,—adhesive weight 34,406 lbs.
24 ton engine on 6 drivers,—adhesive weight 53,760 lbs.
30 ton engine on 4 drivers,—adhesive weight 43,008 lbs.
30 ton engine on 6 drivers,—adhesive weight 67,200 lbs.

CURVES.

"On the Virginia Central Road there are curves of 300 feet radius on a grade of 328 feet per mile. On a level trains run on curves of 300 feet radius at a velocity of 20 miles per hour. (The theoretical elevation for such curves and speed is about 5 inches, and with a 5 inch elevation the curve of 300 foot radius would be safe for a speed of 32 miles per hour, based on allowing two-thirds of the weight to be borne by the outer rail.) A radius of 150 feet, and even less, is practicable; but in such cases the velocity of the train must be greatly diminished.

"There are various formulae for the calculation of the resistance on curves, but the simple inspection of a wheel that has been some little time in use, will show the inaccuracy of the results. The formulae are based upon the supposition that the surface of the tire is conical; this shape is soon destroyed by what is called the channeling of the wheel. The resistance in question can probably be determined only by the result of many experiments with a dynamometer. On the Pennsylvania Central Road, the grade is reduced in curves at the rate of 0.025 per 100 feet per degree of curvature."

Some other items are as follows:

"To lay the rails, the road bed being prepared, crossties placed and iron distributed, a party of six men will lay half a mile of track per day."

"Locomotives weigh from 12 to 30 tons, generally from 20 to 24 tons. they cost $5,000 to $8,500, freight engines being rather more expensive than passenger engines; this includes the cost of an ordinary 8 wheel tender.

"Baggage cars generally weigh 16,000 lbs. and cost $1,200.

"Passenger cars for 50 passengers weigh 12,000 lbs. and cost $2,000.

"Passenger cars for 75 passengers weigh 14,000 lbs. and cost $2,500.

"Freight cars on 8 wheels weigh 14,000 lbs., cost $650, and are about 8 to 10 tons capacity."

For comparison with the above, the following approximate current prices and weights are given:

	Weight.	Cost.
Freight engines, modern	240,000 lbs. to 310,000 lbs.	$21,500 to 26,000
Mallet engines	425,000 lbs.	38,000
Passenger engines	265,000 lbs.	22,500
Baggage car	116,000 lbs.	9,500
Passenger coach (86 passengers)	135,000 lbs.	14,000
Box car	40,800 lbs.	1,100
Pullman car	160,000 lbs.	26,000

"On the New England Roads the average cost of the transportation of freight is 1½c per ton per mile."

"The transportation of passengers costs about 1½c each per mile. This is the average of the actual running cost, and does not cover depreciation of the road; to provide for this, and to secure a fair profit, it is generally stated that the freight and fares charged must be double the amounts given above."

"In Massachusette the average cost of repairing locomotives is (per annum) 6½c per mile run, for repairing track, exclusive of iron renewal, 11½c."

"The average durability of iron in Massachusetts is not more than 10 years, old rails are re-rolled at a cost of $25 per ton; the ends may be re-welded for $5 per ton. In this connection it may be remarked that the ends of the rails first give way, as a general rule; they are repaired by cutting off the injured part of the upper flange and welding on a piece of "Swedes" bar iron. Small injuries in the middle part of the rail may be repaired economically in the same manner."

"Rails are now rolled from 18 to 23 feet in length; on the New England Roads they average about 60 lbs. to the yard; 90 lbs. to the yard is recommended by many engineers as the proper weight for the Pacific Railway."

"A cast iron wheel of the ordinary size will safely bear a weight of 1½ tons."

"Railway wooden truss bridges cost $30 to $35 per running foot; 200 feet has been found to be about the maximum length that it can safely have; many engineers prefer reducing the length to 50 feet."

"Iron bridges have been successfully and economically used on some railways, and cost $40 per foot."

"Average cost of six Railways" viz.

Massachusetts & Western	155½	miles	53	miles	double	track
Boston & Lowell	26	miles		All	double	track
Boston & Maine	74	miles	46½	miles	double	track
Boston & Providence	43½	miles	15¾	miles	double	track
Vermont Central	124	miles				
New York Northern	118	miles				

Graduation and masonry—per mile	$17,343.00
Wooden bridges, per running foot	31.90
Iron bridges, per running foot	40.00
Superstructure, including iron, per mile single track	8,042.50
Engineering, per mile, main road	1,411.60
Total cost per mile main road in running order	62,561.00
Total cost per mile main road in running order exclusive of land damages, stations, etc.	46,619.00

* * * * * * * *

"The length of this route from Fulton to San Pedro is 1,618 miles.

"The sum of ascents and descents, 32,748 feet.

"To overcome which is equivalent, in the cost of working the road, to traversing a horizontal distance of 621 miles, and the equated length of the road is 2239 miles."

"On the New York roads, in 1853, the average cost of maintenance of way, was

For passengers	$455 per mile of road
For freight	323 per mile of road
Total—about	778 per mile of road

(The cost of maintenance now runs from about that figure up to possibly $1,800.)

* * * * * * * *

Here follows a report of Chas. H. Poole, Chief Engineer, San Diego & Gila Southern Pacific & Atlantic R. R. Co.

"Two estimates are given, assuming for the purpose of this estimate, that the route is about equally divided into two classes

of cheap and expensive work, though the cheaper is largely in excess; we have 10 miles at the western end and 85 miles at the eastern end to be estimated at the lower rate. The probable average cost of a single mile of this class at present prices, in California, will be for graduation, bridging and masonry:

10,000 cu. yds. earthwork at 30c	$3,000.00
10 ft. bridging at $15	150.00
Culverts and drains	30.00
Cost of graduation and bridging 1 mile	$3,180.00

"The probable cost of a single mile of the more expensive work will be for the same:

50,000 cu. yds. earthwork at 30c	$15,000.00
10,000 cu. yds. rock excavation at $3.00	30,000.00
500 cu. yds. masonry at $10.00	5,000.00
10 feet truss bridge at $40.00	400.00
15 feet trestle bridge at $20.00	300.00
300 feet small drains and culverts	300.00
Grubbing and clearing	200.00
Cost of graduation, bridging and masonry, 1 mile	$51,200.00

Estimated cost of superstructure for one mile:

2,000 oak ties at 80c	$1,600.00
90 tons iron rails (60 lbs.) chairs and spikes at $80	7,200.00
Transporting material, track laying, etc.	1,000.00
Cost of superstructure, one mile	$9,800.00

(The price of the rail, $80, is considerably higher than at present. It now runs about $25 or $30 besides the freight.)

Estimated Cost of Equipment.

"The cost of equipment for the whole road complete will be:

10 locomotives and tenders at	$8,000	$80,000.00
24 passenger cars at	2,500	60,000.00
6 baggage cars at	1,200	7,200.00
20 cattle cars at	600	12,000.00
40 freight cars at	800	32,000.00
15 gravel cars at	500	7,500.00
10 hand cars at	100	1,000.00
Cost of locomotives and cars		$199,700.00

For Buildings and Fixtures.

Two freight and passenger depots at Termini		$ 30,000.00
Three engine houses at	$8.000	24,000.00
Three turn tables at	3,000	9,000.00
Six way stations at	1,000	6,000.00
One machine shop		20,000.00
Five artesian wells on deserts at	$4,400	22,000.00
Cost of buildings and fixtures		$111,000.00

Cost per mile of cheaper half—graduation, etc.	$ 3,180.00
Superstructure	9,800.00
Equipment	1,635.00
Total cost of cheaper half, per mile	$14,615.00
Number of miles	95
Whole cost of cheaper half	$1,388.425.00
Cost per mile of expensive half, graduation, etc	$51,200.00
For transportation add 25% to superstructure	12,250.00
Equipment	1,635.00
Total cost per mile of expensive half	$65,085.00
Number of miles	95
Whole cost of expensive half	$6,183,075.00
Whole cost of cheaper half	1,388,425.00
Whole cost of road in working order	$7,571,500.00

"The duty on railroad iron being 30 per cent, the cost of superstructure would be materially reduced by a revision of that charge, making a saving of about $1,000 per mile, and reducing the cost of the road as estimated to $38,840.00 per mile. The low rate at which the cheaper of these estimates is placed, will not be a matter of surprise when we reflect that more than half the distance on the desert will be built without the necessity of graduation or preparing the ground in any way for the reception of the rails."

* * * * * * * *

As the above are simply quotations from an old document, there is but little comment to make, except comparison to present practice.

Grades on many roads are now being reduced to 0.3 per

cent, or 16 ft. to the mile, to allow of larger trains, and engines are being built as large as possible, regardless of the wear and tear of the rails; curvature is also being reduced as much as possible.

The heavy freight engines quoted as having a load of 55,000 lbs. on 6 drivers and hauling a load of 250 tons on 1 per cent grades may be compared with modern engines. As the tons used through the report are 2,240 lbs. the above engine would haul a load of 281¼ tons on a 1 per cent grade, engine and cars being included in the load. A modern 95 ton Consolidation Engine, having 169,000 lbs. on drivers, is rated at 1200 tons in 34 cars on 1 per cent grades, adding engine and tender gives a load of 1372½ tons.

Formulae.

Taking into consideration the ton of 2,240 lbs. the formulae mean that the resistance of gravity is 20 times the rate per cent of grade; the 8 lbs. per ton to keep moving is not far distant from present practice.

Adhesion of 20 per cent of weight on drivers is used—present practice is 20 per cent on bad rail and 25 per cent on good, average 22½ per cent.

A modern 10 wheel passenger engine of 205,000 lbs. of which 155,000 is on drivers will make good time on 1 per cent grades with a load of

Tender—loaded	172,000 lbs.
Mail car	128,800 lbs.
Express car	128,800 lbs.
Baggage car	123,800 lbs.
Day coach	120,000 lbs.
Two chair cars	244,000 lbs.
Dining car	142,000 lbs.
Two Pullman cars	250,000 lbs.
Say 200 passengers	30,000 lbs.
Baggage, mail and express	40,000 lbs.
Total	1,379,400 lbs. or 689¾ tons

It will be noted in Lieut. McClellan's figures that the weight of car is 960 lbs. per passenger, in the present chair car, allowing 60 passengers, it is 2,033 lbs.

Freight cars weighing 14,000 lbs. carry a load of 8 to 10

long tons—average 20,160 lbs, or 1.44 tons load for each ton of car.

Present day coal cars weigh 50,000 lbs. and carry 110,000 lbs. —a ratio of 2.2.

It is stated that the safe load on a cast iron wheel is 3,360 lbs.,—but the average load of 9 tons added to car gives 4,270 lbs.

The distance, Fulton to San Pedro, is given as 1618 miles,—sum of ascents and descents, 32,748 feet, equals 621 miles distance—this considers one foot of rise or fall as equal to 100 feet of distance. (More nearly 10 ft. to 20 ft. than 100 ft.)

Mr. Poole seems very stingy with 10 feet of bridging per mile. This would be very, very small, even on a desert.

It will be noted that passenger service seems to have been considered more important than freight service, 40 freight cars are allowed to 24 passenger cars. At present the ratio would be about 1200 freight to 24 passenger.

The list of equipment as compared with the Texas R. R. Commission report is:

Mr. Poole's 190 miles.		Per mile	Texas R. R. Commission 14,325 miles.		Per mile
10	Engines	0.053	1889	engines	0.133
24	passenger cars	0.126	895	passenger cars	0.063
6	baggage cars	0.031	371	baggage cars	0.026
20	cattle cars	0.015	3549	cattle cars	0.242
40	freight cars	0.210	42956	freight cars	3.000
15	gravel cars	0.079	1083	gravel cars	0.075
10	hand cars	0.053	....	hand cars	0.15
			31	office and pay	0.004
			50	derrick cars	0.0035
			951	caboose cars	0.066
			1818	other road cars	0.126

Three thousand cross ties per mile—or more—are now used instead of 2000. Way stations are figured about 32 miles apart and no passing, yard or other tracks are provided. No provision is made for section houses, ballast, fencing, stock yards and a number of other items necessary to operation. Building half the line in the desert, without grading or preparing the ground in any way sounds strange to our ears.

No doubt the early railroads served the purpose fairly well, but as compared with the present, they were only toy railways.

DISCUSSION.

Mr. Hunter. Mr. Hendricks has some sections of old rails here that he would like to show.

Mr. Burton. While we are speaking about rails, there is an interesting report that was made at the time of the construction of the Pacific Railroad in 1862. This report is a collection of letters of recommendation written to the Board of Engineers on the physical standards for the Pacific Railroad, the Pacific Railroad meaning the Union Pacific, Southern Pacific and Central Pacific. There is a letter here which was written by the Superintendent, I presume, for some high official of the Pennsylvania Railroad in 1866. In talking of rails, we often hear the remark made that we are not getting the rail to-day that we used to get; that is, a rail of such good weight, and it is interesting to note that they had the same trouble back in 1866,—that they were not getting the same result they used to.

I quote from a letter written by Philip S. Justice, dated January 20th, 1866:

"Sir: Referring to the late conversation between us in the office of the Pittsburg and Fort Wayne Railroad Company, in which you requested me to write you my views on the economy of substituting the Bessemer cast-steel rail in place of the iron, I start upon the broad ground of the absolute necessity of employing some better material than the ordinary iron now used. Were it possible to always obtain iron rails of the quality formerly made, (regarding the endurance of which we occasionally hear such wonderful accounts), I question whether Mr. Bessemer would have ever thought it necessary to roll steel rails."

(Discussion of this paper will be continued in the next issue.)

OBITUARY

Herman Charles Meinholtz.

MEMBER ENGINEERS' CLUB OF ST. LOUIS.

HERMAN CHARLES MEINHOLTZ was born February 7th, 1868, at Saint Louis, Missouri, and died there Dec. 24, 1913. He attended public school through the eighth grade, entering the Manual Training School in the fall of 1883, from which school he graduated in 1886. After a few months as assistant in the Washington University Testing Laboratory under Professor J. B. Johnson, and a few more months as time-keeper for Shickle, Harrison & Howard at Twelfth and Gratiot streets, he entered the employ of the Heine Safety Boiler Company at the age of 19 as Draftsman, and was continuously connected with that company up to the time of his death.

At the beginning of his connection with the Heine Company, it was in its infancy, and he literally grew up with it, coming in contact with every phase of the business, although his work was mainly in connection with the practical side.

He was made Superintendent in 1895 and Vice-President in 1907. He had entire charge of the Company's shop when it was established in 1899, and under his general direction their new factory was designed and built in 1909, and had since been under his direct supervision.

Although of a very modest and unassuming disposition, he made many friends and was a keen observer and judge of men. He was by nature honest and courageous, and while slow to form decided opinions, after having once arrived at a conclusion he very persistently maintained it, and his judgment was usually justified by the results.

He was a member of the Engineers' Club of St. Louis, and of the A. S. M. E. In the latter he was serving on a Committee to Formulate Standard Specifications for the Construction of Steam Boilers and Other Pressure Vessels and for the Care of Same in Service.

In 1891 Mr. Meinholtz married Miss Minnie Eller, and is survived by her and five children. (Signed) E. R. FISH.

James Charles Haugh.

Member of the Louisiana Engineering Society.

In the recent death of Mr. James C. Haugh, former President of the Louisiana Engineering Society, the Society has lost one of its most beloved and valued members, and one whose ability as an Engineer was recognized by all who knew him.

Mr. Haugh was born in Cincinnati, Ohio, on March 23rd, 1855. His parents were Thomas and Jane Watts Haugh. While still a youth, he entered the office of General A. J. Hickentooper, City Surveyor of Cincinnati, and finished his high school course at night. He served as Rodman and Instrumentman on City Topographical Survey work.

After remaining with the City for several years, he became connected with the Portsmouth and Ohio Railroad for a short time, leaving this position to go with the Cincinnati Southern Railroad, as Resident Engineer in charge of tunnel arching and grade construction.

In August, 1881, he became connected with the N. O. & N. E. R. R. Co., as Transit Man on Surveys, then Resident Engineer, which latter position he held until his death. Mr. Haugh had charge of the construction of the famous twenty-two mile trestle across Lake Pontchartrain, which was built in 1883, then the longest bridge in the world.

In the long administration as Resident Engineer, Mr. Haugh had charge of the maintenance of track and roadway, bridges and buildings, and of all construction work, including yards and tracks, machine shops, passenger and freight depots, culverts, wharves, and numerous iron spans, and always served his Company as an efficient and able Engineer.

Mr. Haugh was well known as a timber expert, and his experience in this line was large and varied.

Mr. Haugh's connection with the Louisiana Engineering Society dates from its organization in 1898. He was always a loyal member, ready to serve the interests of the Society at all times, and always willing to contribute technical papers and join in the discussion of same. He served as Treasurer for five years, from 1906 to 1910 inclusive, and as President one year, in 1911.

Mr. Haugh remained single and was deeply devoted to his aged mother, who died a few years ago. He was also devoted

to his sister and to her son, supplying him with the necessary means for a Yale Academic and Law education.

Mr. Haugh's kind and tender nature drew to himself the true friendship of all who knew him. His fellow members of the Society deeply feel the loss of their old friend and past official. Those who knew him best will always cherish his memory.

The Louisiana Engineering Society deeply deplore Mr. Haugh's death and extends to his relatives its sincere sympathy.

(Signed) L. C. Datz,
A. T. Dusenbury,
John J. Steadham

Walter H. Graves
President Oregon Society of Engineers

W. H. Williams

President Louisiana Engineering Society

Editors reprinting articles from this JOURNAL are requested to credit the author, the JOURNAL OF THE ASSOCIATION, and the Society before which such articles were read.

ASSOCIATION OF ENGINEERING SOCIETIES.

ORGANIZED 1881.

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LETTERS TO THE EDITOR.

SUGGESTIONS FOR THE JOURNAL.

Dear Sir: Permit me to congratulate you, and to wish you and the Association of Engineering Societies, success.

If suggestions are in order, I have the following to offer for your consideration: It is of great convenience to anyone making a practice of filing articles desired, instead of Journals entire, to have the articles so arranged that they may be separated. Your Journal of January, 1914, I believe, is so arranged, but it has not always been so.

It would also be excellent to have the reference as a heading to each paper, with the month and year.

If you will refer to the Bulletins of the American Institute of Mining Engineers, I believe you will readily appreciate what I refer to.

Yours very truly,

C. H. SCHMALZ.

Great Falls, Mont., February 2, 1914.

ECONOMIES IN THE SUGAR INDUSTRY.

Dear Sir: Referring further to the article read by the writer before the Louisiana Engineering Society, and which was printed in your February Journal, I beg to advise that the Atmospheric Double Effects, referred to in the above article, have been thoroughly tested out during the months of November and

December, and the work obtained by them has been fully up to our expectations.

We are able to operate the effects with a back pressure of approximately 8½ lb. per sq. in. in the calandria of the first effect, and we find that the temperature of the juices in the vapor heater vary from 180° to 200°, depending on the conditions existing in the factory.

We also find that we could do an evaporation of approximately 8 lb. per sq. ft. per hour, with the double effect under the above conditions.

The final density of the syrup was approximately 25 Beaume at standard conditions. The syrup produced by this effect was of very fine quality, and in one instance we had one of the equipments operating in a sugar factory, making white sugar, and another instance the effect was operating making syrup. We find that the molasses obtained from the washing of the sugars from this effect is of very superior quality and it is considered in the open market here practically equivalent to open kettle molasses and as such brings a very good price.

The writer will be very glad to answer such questions as you may receive from your readers.

Thanking you for your courtesy, we are,

Yours truly,

A. L. WEBRE.

New Orleans, La., February 27, 1914.

THE VALUATION OF RAILROADS.

By F. G. Jonah,* Member of Engineers' Club of St. Louis.

[Read before the Society, October 29, 1913.]

The valuation of public utilities is a subject of increasing importance—much has been said, much written and much done about it in recent years, and much more remains to be done. It is intended at this time to point out particularly the disputed points that have arisen in the valuations so far made, both as to general theory and also as to details regarding the treatment of certain items entering into a valuation.

Railroad valuations have an absorbing interest at this time on account of the recent Act of Congress providing for a physical valuation of all the railroads of the United States. This work will take an army of employes for a period of five years; will cost the Government fully $15,000,000, and the railroads a very large sum in addition, because the Commission is directing that this must be a joint valuation and that the railroad companies must furnish the Commission with all the information in their possession which they may require. The regulations of the Interstate Commerce Commission have not yet been published, but from numerous conferences held with representatives of the railroads it is known that their instructions will be most elaborate and minute. The Commission is directed to find the original cost to date; reproduction new, and the cost of reproduction new less depreciation. The object of this valuation is nowhere disclosed in the Act, but it is generally understood that the same will be used in rate case litigation, and perhaps ultimately as a basis of appraisal in the not altogether improbable event of Government ownership.

Valuations should be made with the full knowledge that they are subject to the review of the courts, and the attitude of the courts should be well understood by the engineer making them. Thus the whole theory of valuations is predicated upon the decision of the Supreme Court of the United States in the Nebraska rate case, in 1898, that: "The basis of all calculations as to the reasonableness of rates to be charged by a corporation maintaining a highway under legislative sanction must be the *fair value*

*Chief Engineer, St. Louis and San Francisco Railway.

of the property being used by it for the convenience of the public."

It is at the starting point that different theories are developed for as to what constitutes fair value and a fair return upon that value has been the subject of endless controversies and litigation. So far, three general theories have been advanced as to what will give fair or true value:

First—The original cost.
Second—Reproduction new.
Third—Reproduction new, less depreciation.

While each of these theories have numerous advocates claiming that the fair value can be measured by whichever one of the three methods they happen to support, it has been held in some cases that they all should be taken into consideration in endeavoring to arrive at a final valuation, and these facts, if they could be definitely known or figured, would be but elements to assist in determining final result.

The original cost appeals to those who believe that the corporations are entitled to earn a certain percentage, which they generously fix at from six to eight per cent on the actual investment, and no more. It is an attractive theory to those who believe that society as a whole and not the owners of property should enjoy the so-called unearned increment of property values. It is manifestly unfair to the railroads to deny them the increase in their property values when they themselves, more than any other single agency, are responsible for these increased values. Original cost to date will be a difficult matter to obtain definitely because the records of the companies will not disclose it. All the railroads can do is to show the cost to them as it stands on their books, but whether that represents true construction cost or not will vary greatly. Many thousands of miles of railway now controlled by the larger companies were built by promoters, and no record of cost can be found at this time.

The cost of reproduction new theory is the one that is undoubtedly the fairest, and the courts have generally held to this view. They have decided in numerous cases that when public utilities are being valued for rate regulation purposes it is the present value of the property which must be taken into account. This gives the companies the right to put in their real estate, right of way, etc., at present market prices and accordingly allows for the

enhanced values as against the original cost. Valuations are generally being made on this basis at the present time.

A single illustration will show what this means to the railroads: Take the case of the St. Louis and San Francisco Railroad, with its 1,500 miles in Oklahoma. When these lines were built the country was largely Indian or Government lands and right of way was granted for a nominal sum, usually $50 per mile. The difference between the actual cost of the right of way and the present commercial or market value of the same as determined by the assessment of adjoining property is over $5,000,000.

Reproduction new, less depreciation. This theory has numerous advocates who claim that this alone represents true value.

There is in much of the literature on the subject of valuations a tendency to regard cost and value as synonymous terms. There may be indeed a very great difference.

The speaker contends that depreciation has no place in a valuation on which rates are to be based, nor for any other purpose in which the public is concerned, unless the depreciation has reached the point where it affects the service. This very rarely happens on a railroad. The depreciation is taken care of in the ordinary maintenance charges. The classification of operating expenses prescribed by the Interstate Commerce Commission provides that this be done. A railroad has only one function to perform, namely, to provide transportation service, and if any road can provide that service to-day as well as it could at any previous time in its history, then there has been no depreciation on that road. While it is true that certain elements entering into the construction of a road do depreciate, the property as a whole does not. It is a matter of common knowledge that the standard of the railroads is being raised all the time.

It is not fair to take into account depreciation without on the other hand considering appreciation. There are certain things in a railroad that appreciate: The settlement and solidification of a roadbed, the gradual adjustment of drainage, *the perfection of an organization,* gives an old established road a value much beyond what it possessed when brand new. Yet, according to the engineers figuring the depreciation, its value would be much less.

In this connection I will quote a paragraph from a paper on

Depreciation, read by Alexander C. Humphreys, President of Stevens' Institute of Technology, before the Gas Engineers of Great Britain:

"Were it not for the fact that many prominent engineers are following the practice of using so-called standard tables in estimating present depreciation, deducting in proportion to the age of the plant, I should not think it necessary to treat this question seriously. This method, reduced to its simplest terms, is something as follows: A plant is assumed to have an average life of fifty years. The average age is found or assumed to be twenty-five years. Result, depreciation 50 per cent, investment impaired 50 per cent.

"Perhaps it is unnecessary to say that the men who err most radically in this direction are book-men, who have had little or the United States, the professors of economics and statisticians are much in evidence at present; and many of these men are striking examples of the 'blind leading the blind.' The recklessness of statement indulged in by some of these men, depending as they do upon the reading of books, often each other's books, is simply appalling. It is still more appalling when we reflect that not a few of these men are teaching their destructive doctrines to the young men attending some of our prominent colleges and universities.

"To determine the amount of actual depreciation of a plant presents many difficulties, and calls for superior capacity founded upon scientific attainments and broad and exact experience. This determination may be required in connection with a change in ownership, that it may be known what expenditures, in addition to the purchase price, are required to bring the plant up to the required productive capacity and efficiency. Or, it may be required to check up the accuracy of estimates on the cost of maintenance, including final renewals. Or, it may be required by a public service commission to test the justice of a complaint as to faulty service. In any case, the facts are to be learned by expert examination of the plant itself, having in mind physical decay, obsolescence, and inadequacy. If life-tables are employed, they should be used with the utmost caution, and then only as a most general guide, and never by those who have not had adequate experience as constructors and operators. Per-

haps the greatest danger in these tables is that they encourage those who are incompetent to think they are competent."

An engineer, in making a valuation of a railroad, should note depreciation in case his report might be made the basis of a sale or lease, as it would be his duty to take this into account so that he might advise his superiors if the property was being properly maintained, or if there might be unusual maintenance charges to be faced in the immediate future.

The theory of depreciation, as applied to a railroad, is not only inconsistent in itself, but has been treated with the greatest inconsistency by the valuations made by the various States.

Thus, in the New Jersey valuation, the item of track laying was depreciated 25 per cent on the assumption that while 50 per cent of the labor was devoted to surfacing and remained in the property undiminished, the other 50 per cent was devoted to the laying of the track and depreciated with the track structure. This assumption is not correct in the first place because the surfacing deteriorates as much as the rest of the track work, and all is kept up by maintenance charges as part of operating expenses.

In a valuation made by the State of Washington this item was depreciated 6.7 per cent; in Michigan 2.5 per cent, while in Wisconsin, Minnesota and Massachusetts no depreciation was made.

In the matter of appreciation the States have also varied greatly. Thus, in Washington, the item of grading in one valuation was fixed at 110 per cent. The engineers of the Minnesota Commission allowed an item for adaptation and solidification of roadbed equal to 21 per cent of the cost of clearing, grading and grubbing. The Massachusetts Commission, in valuing the New York, New Haven and Hartford, allowed $500 per mile for that purpose. Washington, in recent valuations, is allowing the same thing. The Texas Commission treats the matter broadly and fairly and figures that appreciation and depreciation offset each other.

Having referred to the different theories of valuation, we may now refer to the different objects of various appraisals so far made by the different States:

Rate regulation was the object of the valuations made by the State Commissions of Nebraska, South Dakota, Minnesota and Washington, and of the valuations now under way by Oklahoma, Kansas and California.

For the purposes of taxation was the object of Michigan, Wisconsin and New Jersey.

To regulate the issuance of securities was the object of the Texas valuation.

There has been considerable difference in the work of these various Commissions, even when working for the same object. Some of them have been thorough, and the methods generally fair, and the question as to which object best serves the public good is a matter of opinion.

The work of the Texas Commission appeals to the speaker. The issuance of securities, based on a real property valuation, has been a great protection to the investing public. Stocks and bonds can no longer be sold for railroad construction in that State based on nothing but the rosy prospects of a promoter.

There has been a difference of opinion noted in the written discussions of this subject, as to whether or not valuations should differ if made for different purposes. Some contend that a valuation for taxation purposes should be one thing and for rate regulation another. It is believed that the best results will follow if an engineer makes a valuation as accurately as he knows how, irrespective of the purpose for which it is to be used.

As to the actual work of making a valuation, the writer ventures to suggest a few points, the result of his observations in the supervision of valuations for 2,000 miles of line:

It will be found that in starting to make a valuation of an existing line the records will be in most cases very incomplete. There may be a right of way map, and a profile probably, with nothing more on it than surface and grade line, and the absence of quantities, notes of classification of material, and details of structures will almost invariably necessitate the making of a complete field survey, and the new Government valuation contemplates this, and any engineer starting in on a survey should bear in mind that he is to take a most minute inventory of everything that pertains to the railroad. His work should be grouped under the headings provided in the Classification of Construction Accounts of the Interstate Commerce Commission, and we will consider the various steps in construction or reproduction accordingly:

PRIMARY ACCOUNTS.

ROAD.

1. Engineering.
2. Right of Way and Station Grounds.
3. Real Estate.
4. Grading.
5. Tunnels.
6. Bridges, Trestles and Culverts.
7. Ties.
8. Rails.
9. Frogs and Switches.
10. Track Fastenings and Other Material.
11. Ballast.
12. Track Laying and Surfacing.
13. Roadway Tools.
14. Fencing Right of Way.
15. Crossings and Signs.
16. Interlocking and Other Signal Apparatus.
17. Telegraph and Telephone Lines.
18. Station Buildings and Fixtures.
19. General Office Buildings and Fixtures.
20. Shops, Enginehouses and Turntables.
21. Shop Machinery and Tools.
22. Water Stations.
23. Fuel Stations.
24. Grain Elevators.
25. Storage Warehouses.
26. Dock and Wharf Property.
27. Electric-Light Plants.
28. Electric-Power Plants.
29. Electric-Power Transmission.
30. Gas-Producing Plants.
31. Miscellaneous Structures.
32. Transportation of Men and Material.
33. Rent of Equipment.
34. Repairs of Equipment.
35. Earnings and Operating Expenses During Construction.
36. Cost of Road Purchase.

Equipment.

37. Steam Locomotives.
38. Electric Locomotives.
39. Passenger-Train Cars.
40. Freight-Train Cars.
41. Work Equipment.
42. Floating Equipment.

General Expenditures.

43. Law Expenses.
44. Stationery and Printing.
45. Insurance.
46. Taxes.
47. Interest and Commissions.
48. Other Expenditures.

Item No. 1—Engineering:

Here is one place where "Engineering" comes first.

The first actual work done is the surveying of the line, and every stage of construction must be guided by the engineer. As to the cost of engineering, very few roads will have any accurate data. The old construction accounts will probably have been lost or destroyed. A great many miles of railway forming part of the larger systems have been acquired from construction companies whose accounts were not kept in such shape that these various accounts could be separated as now required by the Interstate Commerce Commission, so that a certain amount of estimating will have to be done. Engineering is usually figured as a percentage on the cost of the physical property, including right of way and real estate. This percentage is generally figured at from 4 to 5 per cent.

There has been some criticism of applying a percentage for engineering to real estate and right of way. On this point the Supreme Court in the recent Minnesota rate case decision said:

"The company would certainly have no ground of complaint if it were allowed a value for these lands equal to the fair average market value of similar land in the vicinity, without additions by the use of multipliers, or otherwise, to cover hypothetical outlays. The allowances made for a conjectural cost of acquisition and consequential damages must be disapproved; and

in this view we also think it was an error to add to the amount taken as the present value of the lands the further sums calculated on that value, which were embraced in the items of 'engineering, superintendence, legal expenses,' 'contingencies,' and 'interest during construction.'"

If the cost of acquiring a right of way is covered fully by the multiple or factors, representing its usual total cost, then presumably engineering is taken care of in the factors, but if the percentage for engineering is applied to the market price only, then it most certainly should be applied, for no right of way was ever bought that did not require the service of engineers, first to make the plats and descriptions of the property required, in order to enable the real estate agent to properly negotiate for same and to incorporate correct description in the deeds. Engineers are required in all condemnation cases in court to identify their surveys and maps, to state and point out to juries how the property will be affected by the construction of the line, and their services are required in making the permanent record of the company's title to its property.

Item No. 2—Right of Way and Station Grounds:

On this subject there is more discussion than on any other in the whole valuation. The engineer can obtain the cost of the right of way from the company's records to a certain extent. Many roads have almost complete deed records, and the considerations mentioned in deed would give the greater part of the cost. The deed itself does not, however, disclose the cost of acquisition, and this is a very considerable sum, embracing the salaries of right of way agents, expense accounts, cost of condemnation proceedings and recording fees. This cost has been estimated in various ways, at prices ranging from $30 per deed to $125 per mile. In a reproduction estimate the right of way should be put in at what it would cost the roads to acquire the property now. This sum is greatly in excess of the present market value. This has been proven so often that further demonstration seems unnecessary. The recent decision of the Supreme Court is universally regarded as erroneous so far as it relates to the right of way matters by those having any knowledge or experience in the purchase of property or right of way for railroads. That decision says the roads should put in their property at market value. The market value of course would

be its value for the purpose for which it is being used, and railroad use will be a different one, and carry a different price. It has been found that the right of way through ordinary farming lands cost about three times the farm value of the property. This is due to severance damages, and the other damages which the location of a railroad across a farm entails, the danger of damage to crops, etc., by fire from locomotives, the danger to live stock, and the universal feeling which the people of a community have that while they all want a railroad they prefer its location on somebody else's land. Our recent investigation in one State concerning purchases of additional property scattered widely and covering 110 transactions, shows that the railroad companies paid 2.97 times the sale price of similar kind of property in transactions between private parties.

Item No. 3—Real Estate:

Few roads hold much real estate, which is property not necessary for right of way and station grounds or terminals, but remarks as to right of way would apply to real estate also.

Item No. 4—Grading:

On this point it is very essential to find the original construction notes giving the quantities actually paid for. A re-cross-section of the line will not fully cover this, neither will quantities be ample which are worked from the center heights of cuts and fills as shown on profile. There are many things that will not show on a profile such as the approaches to public and private crossings, the channels that have been made for stream diversions, or perhaps road diversions, but most important of all is the subject of classification—the proper proportion of earth, loose and solid rock. Experience has so far shown that when an old line is re-classified the quantities of loose and solid rock are almost invariably less than the quantities actually paid for on construction. This comes about by the fact that the surface soil is often washed over the slope, a certain amount of vegetation follows, and further that certain classes of material which properly class as loose rock at time of construction completely disintegrate under the action of frost and rains and in a few years give no hint as to the real nature of the material, and this too further obscures the real lines between loose and solid rock.

The slopes of cuts should be struck with pick or bar to determine real condition.

Item No. 5—Tunnels:

Tunnels are usually special contracts and in most cases notes can be found covering cost,—if not, estimates can be made, based on the cost of tunnels through similar material elsewhere, as there has been a great deal of data collected about tunnel construction in recent years.

Item No. 6—Bridges, Trestles and Culverts:

These structures are so numerous that it will be impossible to find data covering the cost of all of them. The portion of the structures above the ground can be measured up and estimated upon, but there may be a great deal of uncertainty as to the foundations. Thus in ordinary pile trestles the penetration of the piling will be unknown, the same as to bridge piers resting on pile and grillage, or the cost of cofferdams in other cases. In these cases, if the plans and records of the company do not give complete information the knowledge of section foreman, bridge and building foreman and other old employes of the company should be utilized, they can oftentimes give information that will enable an engineer to estimate with practical certainty of results.

Item No. 7—Ties:
No. 8—Rails:
No. 9—Frogs and Switches:
No. 10—Track Fastenings and Other Material:

These are the items entering into the composition of the track. Notes should be taken as to the number of ties per mile, kind, whether treated or untreated, weight of rail, weight of angle bars, and the prices used should be the cost of this material at point of origin, plus commercial freight to the division point at which construction was started, cost should include charges for inspection, unloading at material yard, etc.

Item No. 11—Ballast:

This account includes the cost of distributing the ballast on the roadbed and should include all pit or quarry expense, with

commercial freight rate from point of origin to place used. The placing of the ballast under track is charged to Tracklaying and Surfacing.

ITEM NO. 12—TRACK-LAYING AND SURFACING:

Should include all labor of men, foremen, work train service, tools and also transportation charges for labor and supplies used in this particular part of the work. The last item will be a much larger one than generally supposed because that class of labor will not long remain on a job,—usually until they receive one month's pay, after which a new gang has to be recruited. The items under the following accounts can usually be inventoried without much trouble:

ITEM NO. 13—ROADWAY TOOL,

NO. 14—FENCING RIGHT OF WAY,
NO. 15—CROSSINGS AND SIGNS,
NO. 16—INTERLOCKING AND OTHER SIGNAL APPARATUS,
NO. 17—TELEGRAPH AND TELEPHONE LINES,
NO. 18—STATION BUILDINGS AND FIXTURES,
NO. 19—GENERAL OFFICE BUILDINGS AND FIXTURES,
NO. 20—SHOPS, ENGINEHOUSES AND TURNTABLES,
NO. 21—SHOP MACHINERY AND TOOLS.

ITEM NO. 22—WATER STATIONS:

This will require more than an examination of the existing structures. Railroads have spent many thousands of dollars in investigating for water supply. Much money has been spent in drilling wells in certain sections of the country, only to find the water salty or otherwise unfit for boiler use when obtained, and all this development work should be added to this account

ITEM NO. 23—FUEL STATIONS:

Items in this account can be properly inventoried and estimated.

ITEM NO. 24—GRAIN ELEVATORS:

Few railroads have property of this kind, but some have large elevators, and if the books of the company do not show the cost the appraisal should be made by one versed in elevator work.

ITEM NO. 25—STORAGE WAREHOUSES:

No. 26—Dock and Wharf Property:

This kind of property will present no difficulties.

Item No. 27—Electric-Light Plants:

No. 28—Electric-Power Plants:

No. 29—Electric-Power Transmission:

No. 30—Gas-Producing Plants:

Very few railroads have any property of this description, but should they have, the valuation for that particular kind of property should be made by experts familiar with that class of work.

Item No. 31—Miscellaneous Structures:

Miscellaneous structures includes such buildings as section houses, bunk houses, tool houses, stock pens, etc., and are easily examined and correctly measured.

The remaining accounts under Roadway are:

Item No. 32—Transportation of Men and Material:

This is generally understood to include the transportation of contractors' outfits and supplies and not freight on construction material.

Item No. 33—Rent of Equipment:

No. 34—Repairs of Equipment:

No. 35—Earnings and Operating Expenses During Construction:

No. 36—Cost of Road Purchased:

These are items for which no data can be obtained on the ground and will have to be looked for in the Auditor's records. Rent and repairs of equipment will usually run about $300 per mile for time used in the construction of the road. Earnings and operating expenses during construction will not amount to a very large item because the construction period is generally a short one—usually the operating expenses for such period will exceed the earnings, and this is true too in many cases for several years after construction has been finished or during the development period. If true value is the investment, then the deficit from operations should be added to the cost of the property, but so far as I know no State Commission has allowed this.

The second division of the Interstate Commerce Commission Accounts is Equipment, comprising:

Item No. 37—Steam Locomotives:
No. 38—Electric Locomotives:
No. 39—Passenger-Train Cars:
No. 40—Freight-Train Cars:
No. 41—Work Equipment:

The records of the equipment will generally be found in the office of Superintendent of Machinery, or Auditor's office. The book value, or cost, of the same is also found in the Auditor's records, and if the depreciation on equipment is to be taken into account the Superintendent of Machinery or Mechanical Engineer should fix the amounts.

The third division of accounts is entitled General Expenditures, and embraces:

Item No. 43—Law Expenses:
No. 44—Stationery and Printing:
No. 45—Insurance:
No. 46—Taxes:
No. 47—Interest and Commissions:
No. 48—Other Expenditures:

As to the law expenses, this is usually figured as a percentage of the amount of Roadway and Equipment. Some roads figure one-half of one per cent, some one per cent. No definite records will be found showing the legal charges to various classes of work, and the best that can be done is to apply a percentage. It should be borne in mind that legal talent is costly and the percentage be an ample one.

Stationery, Insurance and Taxes are not very great items. Insurance can be figured on the basis of rates made for the insurance of labor against accident and for insurance on perishable material, such as bridge timber, building material, ties, etc., in the material yard.

Taxes can be obtained from the company's records or local assessors.

Interest and Commissions should include the discount and commission on bonds sold for construction purposes. Interest should cover the regular interest rates for money invested in construction work from time enterprise is started until ready for operation. This is usually figured as six per cent on the total cost of work for one-half the period of construction.

Under the heading of Other Expenditures should be included items of a general nature, such as contingencies, franchise value, or going concern value.

As to franchises, some engineers argue that these are conferred by the public, therefore should not be added to the value on which rates are based. This is going on the assumption that franchises cost nothing, which is far from the truth. Railroads usually pay for them in one way or another. It will usually be found that a road obtaining the right to use a street or alley assumes an obligation for drainage, paving and maintenance which amounts to a considerable sum if figured as right of way. Moreover railroads are taxed on franchises and, therefore, should be permitted to add the same to their values.

Going concern value is one that should be taken into account. The mere taking of inventory of material that goes into a railroad and applying certain unit prices thereto may represent the cost of the work, but not the value. The cost of the ties, rails, etc.,—(but for the single item of track laying) would represent as much if piled up in heaps along the right of way as they do in the track, and surely the assembling of all these parts and the making of a continuous line of railroad has added an element of value much in excess of the cost of labor.

DISCUSSION.

MR. J. E. ALLISON. Gentlemen, I am so much in sympathy with most of what Mr. Jonah has said that it is rather hard to get at a discussion on it. But I may be able to bring out some points of view, or some different ways of getting at the same results.

The terminology of Valuation and Rate making is not yet well defined and two men may, in fact, agree, may appear to radically disagree because the terms used have a different meaning to each.

It is unfortunate that the courts and the commissions have used the word Value in the rather broad and reckless way in which they have. It only takes a superficial analysis of the situation to see that (excluding scrap value) rails, ties, or anything that goes into a railroad or other public utility plant have value after they are in the plant only from the fact that

the plant will earn returns and the money value of the plant as a whole rests on returns or the prospect of returns. Of course there is another value to the community which is not capable of measurement in money but the public utility has a value to the investor measured almost entirely by returns and by the stability of those returns.

It is fortunate that the term "Fair Value" has been used by the courts as the object of so-called valuation for we can read into the word "Fair" an interpretation which will make the term "Fair Value" mean an amount which will be a fair reward to the investors and creators of the enterprise for their sacrifices in the service of the public.

Here we have two distinct results. One the "Value" of the property which depends upon returns; the other, the "Fair Value," which is based on efficient investment or costs.

The two things are unreconcilable factors and cannot be combined mathematically any more than can apples be multiplied by potatoes. But it is interesting to note that while in "Valuation" for rate making present "Value" cannot be considered, yet the result of determining the just amount of capital to be earned on should be to make that amount the real "Value" for the future if the proper terms are established. In other words, the results of public valuation should be to create or establish a value which will be "Fair" or "Just." The aim should not be to ascertain the present existing "Value."

The confusion of these two ideas of costs and present values has been the cause of the greatest mistakes of the courts and commissions. One result has been the illogical and, I believe, unjust applications of so-called depreciated values to the investment as a base for returns. The question of depreciated values, I will, however, speak of later if I have time.

Mr. Jonah mentioned the difference between the cost of Reproduction New and Original Cost. Here again we run against the existing confusion as to the actual meaning of terms. Cost of Reproduction New may mean a highly imaginative estimate of the cost to produce a property under the supposition that the existing property is swept away and is to be entirely replaced during one uninterrupted period of construction. Another interpretation of Cost of Reproduction,

which has somewhat more sense in it, is to assume the cost to reproduce the property under somewhat similar circumstances as those under which it was produced, but using the prices of material and labor current at the time of the valuation. A variation of either of these two methods is to use prices or costs made up of an average throughout a certain number of years preceding the valuation. It is evident that this method, which is the prevailing one, is not in reality the cost to reproduce new at the present time, but inclines very much toward one interpretation of the term Original Cost.

The term Original Cost also has more than one interpretation. To some it means going back to the inception of the enterprise, taking into the calculation all expenditures and by this method bring out some basis for a capital item. My own view of this method is that its advocates are somewhat confused, for if the whole history of a plant and business could be accurately known and everything which should have been charged off as it went out of use deducted, then we would arrive at a result which would represent only the present property estimated at what it actually cost. Those who advocate what may be called the historical method of obtaining Original Cost do not seem to see this point. The same result could be arrived at much more easily and accurately by the interpretation of "Original Cost" as the result of an inventory of the present property with costs applied to each item to correspond to the actual expenditure for them including, of course, besides physical property, such actual expenditures as can be shown to have gone into other costs chargeable to investment in creating the enterprise. Perhaps this interpretation of Original Cost might be called "Actual Cost."

There are questions of just what is meant by Going Value, Going Concern Value, Cost of Establishing Business, Capitalized Selling Expenses and numerous other terms, and I might take up more time than could be allowed me in talking of the difficulties of the terminology of valuation work. I mention some of them here as a matter of interest in showing some of the problems to be solved in Valuation Engineering.

Recurring to a comparison of the Original Cost method and the Cost of Reproduction New method as applied to ex-

isting property I believe it can be said that with an equal amount of imagination injected into each case the two methods will bring about very similar results in any valuation of what we may call the short-lived properties. By short-lived properties, I mean Railroads, Street Railroads, Electric Light Plants and Telephone Plants. With the exception of Buildings, Lands and Railway Road-beds, the equipment of this class of property lives a comparatively short time. The time being short and the equipment varied, there is seldom any marked general sag in prices or general rise in prices which will bring about any very different results from the application of original price or present or average prices as used in the Cost to Reproduce New. The Original Cost method is in some aspects theoretically the more just. The Cost to Reproduce is probably the easiest to apply.

I most heartily agree with Mr. Jonah in his stand against deducting from the earning power of an investment, by the application of depreciated values. I believe that such action on the part of commissions and the courts has been a very grave mistake and one which has worked great injustice to the investors in public utility enterprises and will work still greater injustice unless the mistake can be corrected. As I stated before, it is my belief that this mistake has arisen from the lack of a clear differentiation in the minds of the courts and commissions between values and costs. Values, as I stated, depend upon earnings while the real service of the investor to the public has been in placing his capital in the public service for the public use and this capital is represented by costs, not by present values.

One of the fundamental errors upon which depreciation deductions from investment are based is the assumption that a plant has definite life. As a matter of fact plants of any size if maintained have an indefinite life. Each different item of equipment may have a definite life, but if the items as they disappear from time to time are replaced or renewed, the plant goes on theoretically forever and the properly maintained plant eventually attains a permanent state at which it is most economical to operate and maintain. A depreciated value

curve based on composite remainder of life of the items of equipment in any large plant will tend eventually to straighten out along a line half way between the scrap value of the whole plant and one hundred per cent cost. This curve, of course, would be affected by additions to the plant which would make it rise toward the hundred per cent, but never can make it reach it.

It is evident that if depreciation charges are correctly estimated they will be used up piece-meal in replacements as they occur from time to time. The plant should never reach a condition where it must all be renewed at once unless maintenance and replacement have been so neglected as to render it valueless for operation. Such a state of any large plant is the murder of the plant by its management and is not due to natural ending of its life as a whole as is erroneously assumed by many calculators of depreciation.

The subject of depreciation is such a large and intricate one that it is hardly suited to short discussions such as we have opportunity for this evening and I have only mentioned one or two of many aspects of the problem.

The valuation of Land is another of the puzzling questions in public service regulation work. There are some who hold that the railroads or other public utilities should only be allowed to earn on what their land (which includes right-of-way) costs them. I do not believe that this position can be supported unless we say with Henry George that all so-called unearned increment should be taken away from private ownership and vested in the community at large. Certainly it would not appear just, that the public service companies should be placed in a class by themselves and treated by a different rule than that applied to other owners of real estate.

In applying the theory of "Present Cost to Reproduce" to a valuation of land, of course, would be taken at its estimated present cost. If the theory adopted were Original Cost there might appear an inconsistency in using estimated present cost for land. Property in land is, however, by custom, law and fact, a very different thing from property in other things and there are good arguments to support present cost of land even with original cost of other property. In this connection it may be said that the one thing that most of the courts and

commissions are agreed on is that the rigid application of no one theory of valuation should be used. Too rigid adherence to a theory is likely to bring an unjust result.

Mr. Jonah mentioned franchise values and as I take it, believes that they should be allowed to enter into the amount to be earned as an item of value. On this point I believe I will have to differ from Mr. Jonah and to point out that this appears to be another instance of confusing values, with costs. If the value of the franchise is to be considered, it must be calculated upon the basis of the amount of profit it yields or may be expected to yield. The admission of the item on that ground would, of course, bring us again to the conclusion that the calculation of returns must be based on returns. This, as you see, is a reductio ad absurdum. If, however, there has been an actual and legitimate expenditure of capital to obtain a franchise such amount should undoubtedly be allowed to earn returns. It is rather seldom that franchises have been sold, but where they have, no doubt, the courts will allow the amount paid as an item of capitalization for earnings.

Mr. C. A. Hobein. Mr. Chairman, I was very much interested in Mr. Jonah's paper. I am engaged in the bond business in the city and I think there is one point that Mr. Jonah did not bring out wherein the Federal valuation of railroads is going to be of great benefit to investors. I am quite familiar with the Texas law and the Texas Commission Mr. Jonah spoke of, and while they have under their law, valued the railroads for the issuance of stocks and bonds, still the state cannot by this method control the issuance of the stocks and bonds of a railroad. It is necessary to have a Federal law to control this thing entirely. I can cite an example of a case where there are several individual lines in the State of Texas and one line in the State of Louisiana. The line in the State of Louisiana had a bond issue, and these bonds were called. (Some mortgages have a provision whereby the bonds can be called at a certain premium.) These bonds of the railroad in Louisiana were called and a corporation was formed under the Louisiana laws which acquired all the bonds and stocks of the three railroad lines in the State of Texas. These bonds and stocks on the railroad in the State of Texas were issued under an authorization of the State Commission of Texas.

The Louisiana corporation mortgaged the line in Louisiana and pledged the stocks and bonds of the three Texas railroads as collateral security under the mortgage, in addition to the railroad property which they owned in Louisiana. The maximum value of any of the lines in the State of Texas, as placed upon those roads by the State Commission, was about $25,000 a mile. The mileage in the State of Texas was about two-thirds the total mileage of the combined properties. The Louisiana corporation issued bonds at the rate of $35,000 a mile, so that example will show how it is impossible for one state acting alone to control the issuance of stocks and bonds. However, the Texas law is of great value as a guide to the investor, or to the bond house (which first has to invest their own money in the bonds), in ascertaining the equity which may be in the property. In other words, the cash which is in the railroad above the money which the railroad has borrowed, and that is one of the things which the investor in bonds is interested in.

In connection with the work of the Texas Commission, I recently visited a Texas city in which the Commission had made a valuation upon a property which is not yet in operation. The Commission valued the property including all the real estate which the company had purchased. Of course, they had all the records. Being a new company, the records were very complete, all the deeds were on file and they could find out exactly what was paid for the property. As an additional value the Commission allowed them,—the city in question had vacated quite a number of streets,—to capitalize the value of the streets vacated by the city. The Texas Commission makes an addition to their valuation which they call the franchise value. That includes every kind of going concern value, and all the various intangible values. They did not allow this value in this case, but they stated as soon as the property became an operating property the allowance would be made, so for the preliminary issuance of bonds the company is not allowed the franchise value until it becomes a going concern.

As Mr. Jonah pointed out, it is pretty well conceded that the Supreme Court of the United States, in the Minnesota Rate Case, made a very serious mistake. Now I think it is

very important that the Engineers of St. Louis and the United States get their ideas on these matters prominently before the people and in this way, perhaps, affect these decisions of the courts. That decision is now practically a law. It does not make any difference what we think about their decision now, it is gone and past, and it is practically up to the Engineers who know what is proper, I think, to crystallize their ideas and in that way affect public opinions by discussion.

I recently had occasion to read an Engineer's report. This was a report on a natural gas distributing company. The Engineer, in his valuation, gave no details of the way he arrived at his valuation, or the theory he used,—simply making the statement that the value,—in his mind the fair value,—of the property was such and such an amount. Now that does not mean anything to a person,—a statement that way,—unless you know the theory that the Engineer used, and the additions that he made for the various intangible items. Another case is one of a prominent Engineering firm of the United States; in going over their valuation I found they had real estate, furniture and tools included among the items to which they had added 5 per cent for Engineering. Such things as that make people less confident in a report, and those things should be very carefully looked at, I should think.

MR. KRAUSMAN. I would like to offer you a little further discussion of land values. If a railroad owns property that is very valuable for another purpose, and is not as valuable to the railroad as property which costs less, would the railroad be entitled to earn paid dividends on the value of that property for another purpose? Suppose they were using a railroad switch yard that was worth very much money for business houses and was not well situated for railroad yards. Would they be entitled to interest on that land?

MR. C. D. PURDON. Would the railroad have to pay the value of that land?

MR. KRAUSMAN. No, they bought the land thirty years ago.

MR. PURDON. Mr. Brown, can we hear from you on that subject?

MR. BAXTER L. BROWN. There is one point that has not

been discussed relative to values,—if Mr. Jonah did cover it, I did not hear it,—and that is the value of the organization of a railroad. Anyone who has followed the railroad business to any extent knows that there is a great deal of difference in the way of handling an enterprise. To get at the point I wish to make, take the Pennslyvania Railroad as an example and assume that I laid down another road of the same character and value as that,—the physical value of the Pennsylvania Road without any organization. Now what is the difference in value between the Pennsylvania as it exists and my road? It certainly seems to me that this is a large item of value which should be taken into consideration. It takes years to work up such an organization and is surely worth a great deal of money.

Take the Terminal Railroad as another example. Suppose all the men in that organization should be wiped out and new men put in. What service would the City of St. Louis get? Very poor for a long time.

This, in my judgment, is a most important matter and should be added to the physical valuation for ascertaining a value to be used in making rates.

Mr. Allison. Mr. Brown, is, I believe, falling into the usual error of confusing costs with values. The value of the organization of which he speaks is undoubtedly there but that value is demonstrated and measured by its share in earning returns. It therefore cannot be considered unless it is conceded that the returns, and therefore the rates, are to remain practically undisturbed. It would be right to consider as part of the capital item or investment the cost in capital of building up such an organization. To build an efficient organization probably takes actual investment. It is a hard question to measure the amount.

Prof. W. H. Hibbard. I would like to ask Mr. Jonah if he will further discuss for me the matter of depreciation. If I understood him correctly, there should be nothing allowed for depreciation because it is covered by replacement. A few years ago, I traveled over the Shenandoah Lines in Virginia. They had a great many elevated wooden trestles.

Those trestles, of course, have to be replaced. Should there be no depreciation on the original value of those trestles?

MR. H. PHILLIPS. Mr. Chairman, I have been very much interested in Mr. Jonah's presentation of the three lines of investigation to be adopted by the Commerce Commission in appraising the railroads. It is similar to the methods that have been adopted by appraisers of water works for quite a number of years.

When you have compiled all the data under one or all the three heads you are only in the beginning of determining a fair value of the plant. Take two railroads of the same mileage and cost; one may be a great dividend payer and the other a failure on account of the difference in territory served.

You cannot lay down a general rule,—each road is a problem in itself. I do not see how a just appraisal can be made unless all these matters are taken into consideration.

PROF. HIBBARD. May I add an additional illustration to what I gave? For example: The Wabash bridge over the Missouri River at St. Charles, with its trestles on both sides.

MR. H. J. PFEIFER. It has always seemed to me that the basing of rates on the cost value of property used in the service is not entirely consistent with good economic principles. On that theory the more hills cut through, the more valleys bridged, the more streams crossed, and the more expensive the operation and maintenance, the greater will be the permissible earnings; while as a matter of fact the railroad located so as to avoid as many of these obstacles as possible and economically operated and maintained, is the better business proposition. I have often wondered how this matter would be adjusted, whether the rates would be fixed so that the well located, economically managed and operated road will get the so-called fair return of 5, 6 or 7 per cent, or whether it will be permitted to earn a larger return on the investment, so that the road running through the mountains or thinly settled country, or that has been poorly located and extravagantly constructed may live.

Then there is another matter. Mr. Allison does not seem to think that the franchise should be considered as a value of the property. Does he also think that, as is done in this State

and a number of others, a franchise on which a tax is collected should not also earn a return? If the value is there for taxation, it would seem that it should also be there for earning.

Mr. Allison. I do not wish to do more than my share of the talking but as Mr. Pfeifer has asked me two questions I will try to answer him. In his first statement he compares two different roads built at different costs and assumed they perform the same services and asks what is to be done in fixing rates between those two roads, which are, as I understand him, supposed to be competitive. Mr. Pfeifer has here asked one of the unanswerable questions of public service regulation. Public rate regulation and competition are in theory absolutely incompatible. Such a problem as he proposes will undoubtedly arise, but probably less frequently than might be imagined. About the only thing that a commission could do with such a case would be to use its common sense in some sort of a compromise.

Mr. Pfeifer's question in which he states the fact that franchises are valued for taxes can be answered by saying that under real regulation the taxes are charged to operating expenses and paid by the consumer at least in theory. So, theoretically, at least the situation works no hardship on the investor in public utilities. I will say this, however, that my answer to Mr. Pfeifer's question only holds good where we have such regulation of rates as assures the investor a reasonable return on his investment over and above all expenses. Where the company is unable to make a reasonable return on its investment high taxes or, in fact, any taxes are a distinct injustice. It should be taken as an axiom by commissions and by the public that if the public is to regulate public service enterprises it should also protect them, and where they are compelled to serve the community at a loss the community should not add to their burdens by taxation. This is probably a somewhat advanced stand to take but I believe that fair minded men will concede that it is right.

Mr. A. P. Greensfelder. The thing that appears to me from Mr. Jonah's paper is that the whole problem would be simplified if we could induce the powers that be to appoint

experienced railroad engineers on the various commissions instead of appointing farmers and lawyers. We are sure that a man loyal to his railroad would be equally conscientious to his commission when a member thereof. The people should desire their brethren who are on one side of the fence to assist those on the other.

Mr. H. C. Toensfeldt. I have been amusing myself in thinking of these things. I have often thought what we would do when we arrive at what we call a just value. When we permit an organization to earn, say, 6 per cent, we say the gross earnings are so much; cost of operation and taxes so much, and the difference should be applied to the interest on the investment. Now the biggest item is the cost of operation, and if we are trying to establish rates that are reasonable to the public, it is certainly a very vital question to the public whether or not the property is being properly operated, so I do not see how a commission can establish rates without inquiring into the efficiency of operation. If they include that, you have taken away the incentive on which capitalism is based—that a man can get as much out of it as he can—and I think future corporations are apt to be very indifferently managed unless the commissions take a hand. If the commissions take a hand, you have a situation where the Government tells you what you shall charge for a commodity and how you shall make it, and that looks to me pretty much like ownership.

Mr. J. D. Von Maur. I do not believe that I can add anything further to the discussion.

Mr. Purdon. Probably there is a popular clamor that the railroads are over-capitalized and that their bonds and stocks represent a great deal more than the actual value of the investment. If they settle that question and show they are not over-capitalized, it will accomplish a good result and do away with a great deal of this clamor against railroads, but as to regulating rates by just valuation, I do not see how it can be done. You take two roads, as some gentleman said, in different locations. One road can be operated at a ratio of say 60 and another at 80, and they have to carry freight between the same points for the same rate. One fellow won't get a proper return or the other fellow will get too much.

Mr. W. E. Bryan. Mr. Jonah makes one element of the tangible value. It is a question whether bond discount should be capitalized. I think it has been allowed by courts and I think it has not been allowed,—whether bond discounts should be allowed or not.

Mr. Purdon. Is it not an element of cost the same as any other?

Mr. Bryan. I would like to hear what Mr. Allison has to say about it.

Mr. Allison. In answer to Mr. Bryan, I would say that the commissions should take account of bond discount either by allowing it to be capitalized or by considering it in the rate of return, amortizing the discount over a fixed period.

There has been some objection to capitalizing bond discount from the fact that bonds are issued and reissued at discounts which are practically advances in interest rates. If this discount were capitalized each time there is a refunding it would frequently happen that a large part of the earning capital would consist of bond discount. This discount should have been earned from the rates and not allowed to accumulate as capital. Under theoretically perfect regulation it would make no difference to the investor whether the discount were capitalized or amortized by an increase in the allowed rate of return.

Mr. M. Coburn. Speaking of the rate of return, the answer to the question is the ability of the corporation to get more money when they need it. The measure of a reasonable rate of return is the rate at which money can be induced to enter the business. Now that is not always definite,—the rate at which money can be induced to enter it. In other words, the railroads must have a rate of return at which they can get money so that they can grow with the country. The commissions have not yet come to a point where they are dealing with them on this basis, but they will have to.

Mr. Allison. Mr. Coburn has asked me how the commissions will measure the rate of return. In reply to his questions I would say that I do not know how they will measure it, but I thoroughly agree with him that the proper measure

of the rate of return should be the rate at which money can be readily induced to enter the particular enterprise under consideration. There can eventually be no other measure, but I am sorry to say that some of the commisions and courts are trying to measure rates of return by established legal rates of interest with perhaps some slight additions for what they call profit.

While speaking of rate of return there occurs to me a problem which has not yet been squarely placed before the commissions but which is analagous to the question of rate of return. That problem is: What are the commissions going to do to induce capital to enter new enterprises where large risks must be encountered by the initial investors? It is evident that unless a generous policy is adopted there will be a period of stagnation until the commissions realize that their business is not to make arbitrary rules for the returns on capital but to find out the terms upon which capital will seek public service enterprises under natural economic laws. It must be realized that capital cannot be forced into public service but must be offered inducements which will make it volunteer.

Mr. Jonah. If this is the last time Mr. Allison is going to say anything, I had better answer him.

As to what is original cost, there is a difference of opinion among Engineers and among some of the state commission. Personally, I believe original cost should mean the first cost of what we have there now,—although there are some cases where going back to the original construction days and bringing records up to date would change the thing considerably. If we had the original cost of a railroad when it was built and finished, and added the additions and betterments in accordance with the Interstate Commerce Commission's accounting, you would have the original cost to date. But that system of book-keeping is comparatively recent.

Take an illustration from a case on the Frisco: When the line was built from Fort Smith, Ark., to Paris, Texas, it was laid with a light rail, which cost $65.00 per ton. Those rails have been worn out and replaced two or three times since, and although there is a much heavier rail in there now its

cost was $30.00 or $32.00 per ton, and in the aggregate much less than the original rails. In that case it would be to our advantage to use the cost of the first rails, rather than those now in track, but on all the other items I do not believe there is much difference between the original cost and the cost of reproduction new, except in the matter of land. That is the one thing which is permanent and does not change physically, while other things which enter into the construction of a railroad are comparatively of short life. Rails wear out in ten years, ties in eight, buildings in forty, machinery and equipment from twenty to thirty, and so on.

Answering the question of the gentleman regarding trestles and bridges, which deteriorate and are frequently renewed: It is true that they do, but the renewals must be taken care of as part of the operating expenses of the road. It is part of the Interstate Commerce Commission's instructions that maintenance and renewals of structures must be taken out of the earnings, so if your earnings are devoted in part to this purpose the public is not interested in the deterioration.

Referring to the bonds which were issued by a Louisiana corporation, on a line in Texas, at $35,000 per mile, which line had been valued by the Texas Commission at $25,000 per mile: The investors, had they been acquainted with the Texas valuations, might well have asked why the bonds were for $10,000 per mile more than the State valuation. It is only a question of knowing, and the holders who sold the bonds might have told them about the valuation.

Mr. Purdon. It seems to me that the question of depreciation is very largely covered by the fact that if you consider depreciation, every time you put in a new tie you would change the value of your road; if you buy a new car you would change the value of your road. You would have to keep a force constantly employed making a valuation. The railroads do certain work and are in condition to do that work, and as long as they do this, and take care of it out of their earnings, I would say that there is no reason for taking it into consideration at all. If depreciation is allowed, the rates should be sufficient to cover a fair return on the investment, and the depreciation also.

Mr. Allison. We all think so, but to get the courts and commissions to think so is the proposition.

Mr. Purdon. That is what we are trying to do.

Mr. C. H. Fisk. It has just struck me, when Mr. Pfeifer asked his question about the two roads between two points being parallel competing lines, one costing, say, twice the cost of the other: Would not the long and short haul of the short line and long line policy apply? It seems that between the two lines of different mileage, the short line, of course, makes the rate and the long line, necessarily, meets it, and the man with the road costing 100 per cent more than the other is in an unfortunate situation, and he will have to come to the rates of the line with the low cost.

Mr. Purdon. Which will not give a fair return.

Mr. Fisk. That is why it is an unfortunate condition.

Just one thing touching on the bond issue. Mr. Hobein is representing a big bond house here, and this Federal valuation, it seems to me, is one of the best benefits the public will have. The investing public, in looking up the bond issues of roads, will have valuable data on which to go, and they won't be like the Louisiana corporation issuing $10,000 worth of water. As it is now, a good many bond houses and other people will sell you a lot of bonds and you have to take their word for it, but I think that this Federal valuation, being a matter of record, is a great benefit to the public.

Mr. Von Maur. I do not believe I can add anything to this subject. I am sure when the commission reads this discussion there won't be anything more to do.

Mr. ———. Mr. Toensfeldt's remarks, I think, could be answered by citing an example of rates adjusted according to what is known as the London Sliding Scale, by which a corporation is allowed to earn more as a reward for making a saving in the operation expense.

Mr. Purdon. That seems logical.

Mr. H. C. Toensfeldt. I might say that can be answered by the example of Chicago in the street railway proposition. They tried it there,—55 per cent of the net earnings were to go to the people,—and, by some condition of which I do not

know, the city got the worst end of the bargain and are not realizing nearly what was anticipated.

Mr. S. G. Henry. I will have to correct the gentlemen here about the city getting the bad end of the bargain in the Chicago Street Railway proposition. They are so well satisfied with it that it is being extended to the subway system. I am not fully familiar with all the details of the manner in which the valuation was made, but full allowance has been made.

Mr. Purdon brought up the question of making a new valuation whenever a change in maintenance or change in construction was made, but that is all taken care of in the capitalization. I think there are about 10 men in the present Board of Engineers that take care of all charges and changes in the Capitalization account.

Mr. Hobein. Likewise the re-organization now going on in Kansas City is going to be on practically the same conditions as the Chicago settlement of the traction case, and it seems to me that the City of Chicago now has $2,000,000 in cash, which they are going to apply to part of their subway, as earnings from the street railway.

Mr. Von Maur. I think some such arrangement is in operation in the City of Boston with respect to the Gas Company. It is known as the Massachusetts Sliding Scale Act, under which the standard price for gas was made 90 cents, and the standard rate of dividends seven per cent. If, during any fiscal year, the maximum net price per 1,000 feet charged by the Company has been less than the standard price, the Company may, during the following year, declare and pay dividends exceeding the standard rate in the ratio of 1/5 of 1 per cent for every cent of reduction of the maximum net price below the standard price. The standard price is subject to revision at the end of 10 years.

In 1906 a profit-sharing plan was established under which the employes received on their annual salaries or earnings a dividend of like per cent as the dividend declared to stockholders. Every employe, except the President of the Company, is eligible to designation as a profit sharer. In this way, the interests of the employes have been identified with the interests of the Company.

The real test of such a sliding scale will come in the event that labor and materials should increase to such an extent as to make it necessary to increase the rate to consumers.

MR. J. W. WOERMAN. I wish to speak on just one point, viz.,—the valuation of the right-of-way. In my opinion the courts are very unfair when they estimate the value of a right-of-way at the market price of the adjoining land. This unfairness or injustice is probably due entirely to ignorance as to the circumstances under which the purchase of right-of-way usually takes place. In the first place, it is usually by a forced sale. In the second place, the land owner sells only a portion of his tract and suffers more or less damage to the portion which he retains. If a railroad runs across a quarter-section of land the amount purchased may be only seven acres. At $100 per acre this would amount to $700. But if the owner is damaged only $10 per acre on the remaining 153 acres the damages will amount to $1,530, or more than double the cost of the tract actually taken. In other words, the seven acres of right-of-way cost more than three times the market value of the adjoining land,—which is the estimate given by Mr. Jonah for the Frisco. In securing right-of-way for the U. S. Government for the Illinois and Mississippi Canal, I found that the right-of-way cost four to five times the market value of the land,—principally because crossings are much farther apart than on railroads. These ratios hold whether the land is purchased by agreement or by condemnation.

MR. PURDON. I got a letter from a gentleman to-day. He is willing to take $100 an acre for a right-of-way. He is willing to take $17 an acre for the entire property, but he wants $100 for the little piece I want.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, by April 15, 1914, for publication in a subsequent number of the JOURNAL.]

ENGINEERING AND ACCOUNTING—THEIR RELATION WITH SPECIAL REFERENCE TO PUBLIC UTILITIES.

J. B. SCHOLEFIELD, CHARTERED ACCOUNTANT.

[Read before the Utah Society of Engineers, January 16th, 1914.]

Among the many changes brought by time none has been more complete than the change in the relations between Finance and Engineering. In times past the successful promotion of any undertaking involving the use or development of physical means was largely dependent upon the possibility of finding an engineer capable of handling the problems to be faced. The financial backing could be much more easily secured.

With the tremendous advance in engineering knowledge, and the heavy drain upon the world's finances caused by the unprecedented developments of recent years, the positions have been reversed. The necessary engineering skill can be more or less easily obtained, but, owing to the ever increasing demand and the multitudinous opportunities afforded, capital is becoming more and more difficult to interest. The requirements of capital are becoming more exacting and must be complied with to the best of our ability.

It is not now sufficient for the man of vision to paint a picture, for him to be overloaded with the necessary funds for its realization. Few projects are absolutely "in the rough" and estimates of the future must generally be verified from experiences of the past. This is particularly the case to-day when so many undertakings involve the replacement or reconstruction of the result of previous efforts. In many cases the profit to be gained is not what might be called an "original" profit but is often in the nature of a commission on increased efficiency or improved methods. The old gives place to the new but the latter pays for the sins of the former and the margin of profit is therefore reduced.

It is in these circumstances that the accountant has come into his own. Starting as the humble scribe to the "creative genius"—the engineer—he has to-day, in some instances, attained a po-

sition where the hopes of the engineer rest upon his decision. In all cases greater demands are made upon the accountant and the initiation and continuance of important undertakings depend largely upon the figures he supplies and not so much upon the sanguine expectations of the promoter or the developer.

The foregoing is even more true when we turn from the entrancing realm of exploitation to the mundane sphere of operation. With the increasing population and the disappearace of virgin fields for commercial development, financial attention is increasingly focussed upon existing enterprises and the possibilities for their betterment and economical expansion. Competition, including the competition between differing means of production and sources of supply, calls for a closer watch upon the results of operation. Figures supply the medium.

Under these circumstances it should be apparent that it is to the mutual interest of the engineer and the accountant that they should co-operate to the fullest extent and should have a thorough understanding of the difficulties under which they each labor.

When I was asked to address your Society it was with considerable misgivings that I consented, for "there is nothing new under the sun" and the setting forth of concrete facts such as an organization like this is interested in appeared to me to be probably beyond my ability. However, it occurred to me that some brief remarks on the problems confronting the accountant in which he is dependent upon the co-operation of the engineer might be of value and, at this present stage of the country's political progress, a brief discussion of some points in the valuation of public utilities, in which they are both vitally interested, might be of interest.

In times past there have been unfortunate divergencies between the accountant's final figures of cost and the engineer's original estimates. This was doubtless the fault of the accountant but perhaps may be forgiven as attributable to his inordinate desire for accuracy.

The chief mutual interest of the engineer and the accountant centers round the question of costs. I do not now refer to Manufacturing costs, with which we in this part of the country are not greatly concerned, but to the construction costs.

It is essential that the cost of construction be properly kept for the following objects:

(1) The vindication of the engineer.

(2) The scientific provision of depreciation.

(3) The reliable adjustment of cases of renewal and replacement.

(4) The provision of figures on which to base future developments or to recommend new and similar enterprises.

(5) The valuation of property for sale or amalgamation.

(6) The valuation of property for regulation or absorption by the State or Federal Governments.

The history of most undertakings has been one of small beginnings, and here occurs the first difficulty of the accountant. It is naturally felt, when capital is small and hardly obtainable, that the energy of the organization must be concentrated upon the physical work in progress. The accounting end is given small consideration and the records kept are meager and unreliable. In many cases the engineer is the paramount authority and is able, if he will, to insure the starting of a simple yet complete system which shall be of use in the future and can be elaborated as the enterprise grows. I have experienced instances where it was quite impossible to ascertain from time books or payrolls where the work was actually done and, as expenditure on similar work at several locations was all charged to one account, it was impossible to arrive at the cost of each plant.

The books are often kept at a point remote from the actual work of construction. The bookkeeper is unfamiliar with the nature of the work and the lay of the land and is consequently unable to provide intelligent and appropriate records. A preliminary outline by the engineer, showing the general plan to be pursued and the more important items comprised therein, should be provided.

In large undertakings it is worth while to keep elaborate detailed cost accounts in a separate set of books, the balances of which tie in to the controlling accounts in the general ledger. In smaller projects this is not possible and considerable unnecessary expense and trouble is incurred because the engineer insists on keeping his own records of cost for various parts of the work. This is probably necessary in such instances as require records of cost of excavation, grading, concrete work, etc., so that daily costs may be obtained as a check upon the progress made, but the cost of sections of the work can be adequately shown by the

general books if there is a proper understanding between the engineer and the accountant. The former sometimes complains that the divisions adopted by the latter are of no service to him. Some preliminary agreement would doubtless have eliminated this excuse.

Unless the work will bear a heavy accounting cost, simplicity of accounting distribution is essential. I suggest that the following divisions will sufficiently cover the majority of cases (excluding large enterprises):

Material and freight..
Labor.
General expense.
Overhead expense.
Financial expence.

The first three divisions would be titles of accounts for each part of the work sufficiently important to call for separate accounts. Overhead Expense and Financial Expense would, of course, be each in one account for the whole project.

The reason for choosing the first distribution is that, in the West, at least, the delivered cost is the important figure. This account should therefore include hauling and handling. By arriving at the unit cost under this head at the completion of the work it will be possible to make comparison in future years when the questions of replacement, renewal, or reconstruction come up.

The common labor cost should be a separate item because rates change so frequently and much of this work is eliminated from time to time by inventions and improvements.

General expense would include all other expenditures directly chargeable to the section of the work. It may be that engineering is so large an item that a separate account would be desirable. This depends upon the individual circumstances. I shall probably be told that my distribution makes no provision for stores accounts. Needless to say, stores account are extremely desirable if properly kept. Unless, however, a regular storekeeper is kept and a proper system followed, the result is more unreliable than that obtained by making direct charges to the accounts estimated to incur the expenditure for material and supplies.

Overhead expense should not include Financial Expense but

should cover only such supervisory and Executive expenditure as cannot be directly charged to any one section of the work.

Financial expense, which includes promotion expense, discount on bonds and stocks, interest during construction, incorporation fees, etc., should be kept separately. It is absolutely unjust to charge this as a part of the cost but it is often spread over the property so as to hide the expenditure. The conservative method is, of course, to hold this expenditure apart and charge it off to profits over the life of the indebtedness incurred or as a yearly charge over the estimated life of the assets created by the work.

It will readily be seen that the accountant depends upon the engineer for the proper distribution of expenditure and it is therefore the business of the latter to see that he has the means of supplying reliable information. I need only mention two or three desirable methods in this connection:

(1) Blind check on material received.
(2) Proper issuing requisitions.
(3) Individual daily time slips. The usual time book is a delusion and a snare and leaves the way open for a shirker to neglect the conscientious discharge of his duty.
(4) In case of a more or less elaborate distribution the adoption of letters, numbers, or symbols as a means of reducing the labor of distribution.
(5) Correct records of material returned either to seller or to general stock.
(6) Correct records of material remaining on completion of construction.

Let me point out some errors which are not infrequent and which can be avoided if the necessary information is furnished to the accountant:

(1) Construction originally charged to Property account is torn down and replaced by improvement. The cost of tearing down should not be a property charge.
(2) Supplies are charged to Property by one Company and then sold to an allied Company. The sale is credited to Earnings.
(3) Property is "junked" and turned into storehouse without record. There is a surplus on Inventory which is credited to Profits.

(4) Property is torn down and the material used for maintenance without charge.
(5) Overhead and financial expense are omitted from original cost figures when writing off property replaced.
(6) Supplies left over from Construction are not turned in to stores or records furnished. They are later sold as operating supplies or used in maintenance without charge.

In the course of the work the main plan will often be modified and the accountant should then be supplied with a simple and timely notification of the change involved.

The distribution of overhead expense cannot be done intelligently without the advice of the engineer. It is entirely wrong to spread this over according to the total cost of the work. In some cases there will be a large labor charge, involving much overhead expense, with little material charge. In another case there may be a low labor charge with the same amount of overhead expense. In another case there may be a comparatively small material charge on work which has occupied much time in contemplation, planning and supervision. In some cases a low labor charge may mean that the class of labor employed required constant supervision and in other cases a high labor charge may mean that much could be left to the intelligence of the men employed.

The engineer should take the completed cost figure and, from his files and his personal knowledge, make a concise report on each division of expenditure so as to indicate the proportion of overhead expense which should be borne by each.

On other points the engineer can and should furnish information. Take, for example, the question of the charge to be made by one project for equipment loaned to another. This charge may be made either by way of an interest and depreciation charge upon the value of the equipment when received, or by the difference between its estimated value when received and when returned, plus in each case an agreed profit.

It often happens that the construction and operation overlap and that the construction force is used to a greater or lesser extent in the commencement of operations. In that case operating must be charged with certain time, both ordinary labor and

supervision, for supplies used and facilities provided. The information must come from the engineer. This also applies to the proper division of revenue obtained in the transition period.

Certain parts of the work bear, in some instances, what appears to be excessive cost. Only a proper engineering report can interpret the accountant's figures in the light of the difficulties actually encountered so that future valuation and present opinion may be correctly informed.

When actual construction is completed, the engineer can greatly assist the accountant in two ways:

(1) By giving information as to desirable divisions of operating and maintenance expenditure so that the records kept may afford valuable information. He may also be able to suggest proper classification of earnings. This side of accounting is often neglected but is very necessary in comparing periods and in arriving at facts relative to progress and the probability of increase in the future and the justification for additional construction.

(2) The fixing of logical and adequate rates of depreciation. This can be done by a detailed report on the class of construction in each account, its probable life, the estimated maintenance charge and any other useful points. The general practice of using a blanket rate of depreciation to cover a whole plant or even large sections is absurd. The whole question of depreciation calls for a change in treatment. To my mind the only correct method for a large plant or system is the provision of a depreciation and maintenance fund. After proper consideration by engineers and all concerned the probable yearly depreciation and maintenance cost on the several sections should be determined. This cost should be charged up by even amounts monthly and credited to the depreciation and maintenance fund. Against this fund should be charged the actual expenditure for maintenance, replacements, and renewals and complete reconstruction if the property is rebuilt (if the original construction is exactly replaced). The division of the actual expenditure can, if desired, be kept in subsidiary books.

The advantages of this plan are that comparative accuracy is insured in the rate of depreciation and that the cost of main-

tenance is equitably distributed so that the earlier years, in which the plant is new, and the expenditure on maintenance is small, bear their fair share. It may be objected that the business is built up in the earlier years for the benefit of the later years. This has been the excuse for manipulations which are responsible for many of the evils we suffer from to-day. In any event, if this contention be allowed, the honest method would be to make allowance for the "building up" process by crediting Earnings with an estimated amount and carrying a corresponding charge as deferred for distribution over later years.

Where assets are replaced by improved or enlarged units or parts it is naturally claimed that the increased value should not be charged against Earnings. It is necessary, therefore, to charge the cost of original plant cost to Earnings and the improved value to Capital. The accountant must obtain his data from the engineer as the one familiar with the actual physical change. It is hardly necessary to say that the present day cost of the lost asset should be charged to Earnings, not the original cost.

The operating statements issued under this system show a uniformity which is extremely useful as a basis for further capitalization or the marketing of present securities.

A periodical reconsideration of the depreciation and maintenance funds and charges thereto must be had in order to correct the results of any exceptional occurrences or conditions.

The rates fixed should take into account the residual value of the property in reduction of the annual charge.

Depreciation should not be provided on such expenditure as does not require replacement. Therefore, real-estate, perpetual right of way, excavation and grading, and like items should not be included as depreciable.

The Income Tax Law allows "reasonable depreciation." At first the deductions made under this head will doubtless escape minute scrutiny, but as the Act works more smoothly the authorities will certainly turn their attention to this feature. We shall depend upon the engineers to substantiate our contentions as to rates and conditions. It would probably be of great benefit if this Society were to take up the question of depreciation in this section of the country, having special regard to the effects of atmosphere, water, and soil conditions and set forth a sched-

ule of depreciation on well known standard apparatus and material so that these figures could be used to combat the generally erroneous conclusions of Government officials. A result of Government rate fixing can be seen in the maximum rate of "5 per cent of the annual gross outfit" allowed to mines under the Income Tax Law. In the case of one mine with which I am familiar, a mine which is a big producer. it would require 42 years to wipe out the investment if the allowance were based on last year's production. or 30 years if the market value of the stock be considered.

The Supreme Court decided that Mining Companies could not deduct, for depletion of assets, the difference between the value of ore sold and the cost of extraction. This leaves us without any measure of depreciation, if indeed any is permitted to mining companies on other than constructed assets—another instance of governmental accounting. The Income Tax Law corrects this but the decision may serve as an instance of what we may expect from cases brought before the Courts.

When we turn to the special instance of Public Utilities we find that the relation of the engineer and the accountant is particularly important. These undertakings depend for their financial life upon the contributions of a class daily becoming more sensitive—the investor. No longer can the word of one financial power call forth unlimited means for any project receiving his benediction. Facts and figures, verified to the utmost possibility, are demanded and given.

In large projects the continual progress must be shown so that an idea may be gained of the eventual outcome. Additional capital can only be obtained after thorough investigation and, in the capital limited future, the most favored treatment will be received by the corporation able to show actual and provable figures so arranged as to form useful guides to the twice shy investor.

There is another phase of the future which is of even more importance. I believe that most of us will agree as to the practical certainty of one of two things in the near future—(1) State or Government ownership—(2) absolute regulation as to rates or capitalization or both. In either instance some valuation must be made and it will not be the same in both cases. Presumably the Government would decline to pay for money not actually in-

vested, whereas if rate regulation only were desired, some provision would be made for the risks attendant upon continued ownership. It may be claimed that court decisions concede the value of some intangible costs, but it would appear reasonable to assume that, in the event of a Federal scheme for ownership of interstate utilities, some means would be adopted of overcoming the restrictions imposed by past decisions—some of them contrary to a reasonable conception of public rights.

If the valuation be for purposes of rate fixing it is certain that the value must include all money actually expended together with the cost of obtaining same and a reasonable compensation for unproductive years. This may include some excessive items but the community must assume some responsibility for its errors of the past or for the provision of facilities before the locality was ripe for them. The question of depreciation cannot concern the rate fixing body as a factor in the price to be calculated but only as a factor increasing the rate to be allowed. The depreciation should be allowed on the new value of the plant and cannot be claimed at a figure sufficient to make good the ravages of time in a plant where repairs and renewals have been neglected. On the other hand, appreciation of value cannot be claimed for this is the result of the gift or increase of the very public for whom relief is claimed. In the same way a franchise can have no value other than the actual legitimate cost of obtaining same.

Valuation of public utilities for absolute purchase may be affected by a government right to instal competitive plants in case of alleged exorbitant demands on the part of the public utility companies. Assuming that both sides are reasonable in spirit we may fairly claim that the corporation is entitled to payment for cash actually expended, a reasonable financial cost, the average market valuation for some period prior to proposals of government ownership for the stock issued purely as bonus, a reasonable compensation for the market building period (such compensation to become less as the company grows older) and some value for appreciation where the far sightedness of the promoters can be shown. Depreciation not made good would undoubtedly be deducted and regard would be had to the conditions of ownership and operation as they had affected profits.

The ethics of government acquisition may be said to rest upon the assumption that value conferred by the people may be taken by the people, after allowing reasonable compensation for

private capital employed and risks undertaken. Assuming the accuracy of this assumption it is evident that little value will be attached to franchise rights, appreciation through increase of population or age of property, promoters' bonus (except where represented by stock which has acquired a market value in the hands of "innocent" holders) and similar terms. It is therefore essential to show all the legitimate expenditure involved and that records should be easily verified and explained. Corporations able to supply information readily and clearly are likely to receive better treatment than those which must resort to estimates and put forward claims not represented by actual figures.

The presumption stated above excludes all question of replacement value. This method of valuation must be resorted to when original records are not available but is fraught with dangers. If credit is taken for the increased prices of the later date it would be perfectly reasonable to insist that the heavy promotion and financial bonuses imposed in the past, but no longer tolerated by public opinion, be eliminated. If, however, by replacement value we mean the cost to replace the original construction at the original figures, the value of correct records is again evident. There are, however, some values which, under ordinary bookkeeping methods, would not be recorded. Such values are those for right of way and land donated and taxes remitted. These have a legitimate value to the Company and should be recorded by the man on the spot, the engineer, through his report or by notification to the accountant who can record same by a ledger account note or in some other appropriate book. On the other hand there are certain recorded expenditures which are not represented by assets to which the Corporation has title. These include such expenditures as are made on city streets and in other public places in consideration of rights or privileges acquired. A Physical valuation of the property might overlook this cost unless specially segregated on the books or specifically reported.

In conclusion let me express the hope that this somewhat random paper will stimulate interest in the accounting work of enterprises with which you may be connected. Interest is prone to wane when Construction is completed and the humdrum work of Operating begins. You can, however, usefully give some attention to the Operating records. By suggestions or instructions as to proper division of earnings, by information as to

which parts of the property or types of the construction are deserving of special record as to operating costs and results you can ensure useful records. Correct and reliable statements breed confidence, and confidence is the forerunner of enterprise. When enterprise is widespread we all gain, and in the creation of confidence one project successfully constructed and operated is worth a hundred glowing prospectuses.

This paper does not exhaust the subject and is written more as a basis for discussion than as containing only incontrovertible facts. I shall therefore be glad to endeavor to answer any questions which you may care to ask.

[Note.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, by April 15, 1914, for publication in a subsequent number of the Journal.]

EARLY RAILROADING.

By Richard Morey,* Member of Engineers' Club of St, Louis.

[Read before the Society, November 5, 1913.]

A story connected with early railroading has come to the speaker, partly through accident, and it is submitted, not as a discussion proper on "Railroading Sixty Years Ago," but as additional matter of possible interest.

The firm of which the speaker is a member recently executed a contract for the construction of the Apalachicola Northern Railroad in Western Florida. Part of that line followed the right-of-way and old grade of the Lake Wimico St. Joseph Railroad, which originally operated from a point on the Apalachicola River to St. Joseph Bay, a deep water harbor on the Gulf Coast of Florida. This latter road was built about 1832, and abandoned about 1841, when its property was sold to satisfy the company's indebtedness. The track was built with pine ties and stringers with a strap of iron fastened to the stringers with hand wrought nails. Remains of this old track were still in evidence when the new road was built in 1910, although pine trees thirty inches in diameter had grown in the old roadbed, the timber used having been largely "fat wood," or a resinous pine. The equipment consisted of walking beam engines and small flat cars, some of which carried wooden benches for the accommodation of passengers.

The business of the road consisted mainly in the transportation of cotton which was brought from Alabama and Georgia, on barges, down the Apalachicola River and transferred over the railroad to the deep water at St. Joseph Bay. The only suggested economic reason for the final failure of the project, after several prosperous years, is that the construction of roads to the Atlantic Seaboard provided, for this cotton, transportation facilities far superior in service and time.

The speaker recently saw a copy of the Charter of this old railroad company and remembers that it contained a clause which was seemingly an effort to prevent the use of the railroad as a toll road by anyone having suitable equipment.

*President, Morey-Fraulhaber Construction Co.

About the time of the completion of the speaker's work in Florida he heard a gentleman in the smoking compartment of a train through the Southwest remark that his grandfather had been a resident of the old town of St. Joseph, Florida. Further information proved that the grandfather had been the late Raphael J. Moses, of Columbus, Ga., who during the Civil War was an officer in the Confederate army and, afterward, Congressman from Georgia. Late in life he wrote a very interesting memoir giving the experiences of a long and eventful career. That part which refers to the railroad follows, and applies to the period from 1836 to 1841:

"While at Tallahassee the new town of St. Joseph had been started and lots were sold for immense prices. It was started in opposition to Apalachicola, which was owned by the Apalachicola Land Company, which held the lots in Apalachicola at exorbitant rates. St. Joseph had a fine climate and a bay said to be as beautiful as the Bay of Naples. Its approach was easy, while Apalachicola had a very expensive litherage and was not regarded as healthy. A syndicate from Columbus bought up the land on St. Joseph's Bay and connected it with the river by railroad. I went over to St. Joseph with a party of gentlemen, having no idea of locating there, but when I got there the town was 'on the boom.' Lots 80x100 were worth $5,000.00; it was but a few months old and shipped 30,000 bales of cotton. Butran, the Secretary of the Railroad, died while I was on a visit there, and strange as it may sound, I got the situation of Secretary to the Lake Wimico St. Joseph Railroad at a salary of $2,000.00 a year. So much for being a pleasant fellow, knowing how to tell a good story and telling them on all occasions, withal being a good book-keeper, the very thing the railroad company wanted. I think that was along in 1838.

"I tried to hire a house and offered $600.00 a year for one that I couldn't get. I then hired a temporary place and had a house put together in Charleston by David Lopez at a cost of about $600.00 and shipped to St. Joseph, but carpenter's wages were so high that this house in the course of three or four years, with improvements and additions, cost me over $4,000.00. But about the year 1843, the yellow fever broke out in St. Joseph and was very fatal."

* * * *

"The town went down, the railroad failed, and I bought for $37.50 the house and lot that a few years before I had offered $600.00 a year rental for."

"The railroad company had judgment against it for $180,-000.00 and it had out about $50,000.00 in bonds which were deemed of no value, but each bond said on its face, 'The property of the Company mortgaged to pay this bond.' I examined the mortgage and found that it ante-dated all of the judgments, and it occurred to me at once that every bond holder was an equitable mortgagee. I went to work to get control of the bonds on a contract of 5 per cent, (with more experience I should have charged 25 per cent, which would have been freely paid) on the amount of the recovery. Now my trouble was that if I kept right on the Law I didn't know what steps to take to assert the rights of the bondholders, so I went over to Tallahassee, consulted Leslie Thompson, afterwards Judge of the Supreme Court of Florida, he said I was right and we would have to file a bill. I associated him with me and to be brief, we got a decree subjecting the property.

"I then got a new Charter, passed under a different name from the old ones, went first to Columbus and got several stockholders in the old company to agree to buy the property for the amount of the old bonds: If I could get a new Charter so that they could reorganize and start St. Joseph free from the old judgment.

"I did all this, sold the property to the new company, collected the bonds and my fee, and they spent several thousand dollars in re-fitting the railroad and wharves and then it was St. Joseph was visited by yellow fever and the whole thing went to smash."

* * * *

"I made a very large fee, I think it was $2,500.00 foreclosing a mortgage on the St. Joseph Railroad, a mortgage made by the new company in favor of John D. and Wm. Gray. They bought it at the sale, took up the iron and carried it to Georgia to complete a contract they had for the building of the Monroe Railroad.

"St. Joseph went all to pieces, the very brick chimneys were taken down during the war to make salt vats for evaporating the salt water. The graveyard is the only land-mark left of the former city. It is again as it was before St. Joseph was founded, a wilderness of pines where the deer and bear roamed unmolested."

In a copy of the St. Joseph Times, of June 16th, 1840, appears an advertisement of the old railroad company referred to and it is given here as showing the rates charged for a thirty-mile haul.

St. Joseph and Iola Railroad.

"The undersigned announces to the public that the St. Joseph & Iola Railroad is now completed and open for purposes of transportation.

"Cars suitable for the transportation of all kinds of merchandise, building materials and live stock are provided.

"A wharf and warehouse are erected at the Chipola Depot where goods and produce to and from the interior will be received or delivered.

"The houses and cotton sheds attached to the Railroad at Iola and St. Joseph are large and commodious and cotton and other merchandise, if so directed, will be placed at either point under cover.

"The despatch, economy and safety with which merchandise and produce may be transported by the new route, through the city of St. Joseph, when practically tested, will be fully appreciated by a discerning public, and all the undersigned now asks is that the Planters, Cotton Buyers and Merchants of the interior will make the experiment, confident that it will result to their profit and satisfaction."

"Rates of Charges Established on the St. Joseph & Iola Railroad.

Transportation.

Passengers, each	$1.00
Children, under 12 years of age	.50

Merchandise.

On each bale of Cotton, per bale	$ .15
Hhds., Bbls., half & qr. Casks, Tierces, Boxes, Bales or Packages of Merchandise, at the rate of per bbl	.10
On each bag of Salt, Coffee, Pepper and Pimento, Corn, Oats or grain of any kind not measuring over 5 ft. per bag	.10
On all iron castings, kegs of shot, lead, or nails, grind stones, mill stones and all heavy articles, at the rate per hundred pounds	.05
Lumber, etc., per 1000 ft	2.50
Bricks, per 1000	3.00
Shingles, put up in bundles, per 1000	.50
Shingles, per 1000, in bulk	1.00
Staves, per 1000	2.00
Hoop poles, per 1000	.50
Wood, per cord	2.00
Pine or Oak Logs, per cubic ft	.03
Cedar Logs, per lin. ft	.01½
Gigs & Carts, each	1.00
Four-wheel Carriages, each	2.00

LIVE STOCK.

Horses and Oxen, per head	$3.00
Cows and Calves, per head	2.00
Sheep and Hogs, per head	.25
Poultry, per 100	1.00

WHARFAGE.

On each bale of Cotton, per bale	$ .03
On each Barrel of Merchandise, per barrel	.03
On all other heavy Goods, per 1000 lbs	.10

STORAGE.

The following rates will be charged on all goods and stored in the Company's Warehouses:

On each bale of Cotton, not exceeding 60 days, per bale	$ .15
On each barrel of Merchandise, etc., not exceeding 60 days, per bbl.	.10
On all Measurement goods, per foot	.02
Iron Castings & all heavy articles, per 100 lbs	.05

JOHN D. GRAY, Agent.

St. Joseph, October 28th, 1839."

The last paragraph quoted from Mr. Moses, would have been as true in the early part of 1910 as on that remote date when the Southern army used those remaining chimneys in securing salt for its commisary. By the end of 1910 the new railroad was completed to St. Joseph Bay, a dock constructed accommodating vessels drawing thirty feet of water and to-day, the new town of Port St. Joe, with railroad headquarters, hotel, schools, electric light and ice plant, fish packing plants. and a traffic over the docks greatly beyond the old town's 30,000 bales of cotton, furnishes employment and homes for 3,000 inhabitants.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, by April 15, 1914, for publication in a subsequent number of the JOURNAL.]

DISCUSSION OF PAPER ON "THE STATUS OF THE ENGINEER."

[Vol. 52, page 4, January, 1914.]

Mr. F. Y. Parker. (Member of the Engineers' Club of St. Louis.) All Engineers will agree with Mr. Wall, that "status of the engineer has long been an aggravation to the members of the profession;" in fact it is a thorn in the professional flesh to read of men, dubbed engineers, who advocate costly and often preposterous projects foreordained to failure. Although many of these projects are brought to completion, nevertheless, they can only be classed as failures, when measured by the *Engineering News*' definition of an engineer. Everyone of these structural and financial failures are flarebacks which the press headline and the public debit to the profession.

That the profession is both old and honorable is amply proved by the remains of aqueducts, reservoirs, and canals that have stood the ravages of centuries. Many of these hoary works were so well constructed that they are utilized in modern practise. Instances are the irrigation project in Mesopotamia, and part of the Nile irrigation system. Who shall say that the Pyramids, the Hanging Gardens of Ancient Babylon, and the Norias in use at the present day, were not designed and built by engineers? Regarding the engineers of these ancient works, it can be truly said "by their works ye shall know them," for, although their names have long been forgotten, these relics of the past are enduring monuments to their ability.

There is nothing more true than that membership in a national society should be a certificate of unqualified indorsement; but in how many societies does this interpretation of membership obtain? How many societies are there where membership means, either to its members or to the public, much more than the right to wear a badge, the receipt of a magazine, and invitations to meetings and entertainments? Lack of ability and experience, although a member of a well known society, is undoubtedly too large and unpalatable a pill to give to the public many times and retain its confidence.

If national societies would adopt as their slogan, quality

not quantity; standardize their qualifications for admission and appoint (as suggested by Mr. Wall) a publicity bureau; the present generation of engineers would probably suffice to teach the press and the public "the status of the engineer." That the press is in sore need of being taught is evident every time our wielders of the pen and ink-pot attempt to delve beneath the surface of engineering works. A glaring example was the criticism of that part of the Board of Engineers' report on the Lakes to the Gulf Waterway project, relating to cost compared with present and prospective traffic. The howl from the press was unanimous, that this part of the report was entirely outside the province of engineers. Shades of Caesar! almost the first question asked an engineer, in private practise, is, will it pay? Archimedes volunteered to move the earth if furnished with the requisite length of lever; engineers can do practically anything if furnished the money; but the fulcrum will ever be, will it pay?

The *Engineering News*, of January 22, 1914, contains an article, "The Publicity Work of the Cleveland Engineering Society," which indicates what has been done by a single local society. Two excerpts from this article follow. "The experience of over a year in publicity work justifies the statement that more frequent appearance of engineers before the public, both personally and in writing, will result in mutual benefit to the engineering profession and to the public." "Conditions in Cleveland may be somewhat different from those in other cities, but they are not so unique or unusual but that it is safe to say that similar results may be produced with like effort anywhere." The last four words end this article; but they tell the whole story of how to get results.

In *Engineering News* of the same date are two editorials that touch the subject under discussion; one, "A Proper Plan for Promoting Publicity," is called forth by the work of the Cleveland Engineering Society; the other, "The Compensation of Engineers," is a subject fraught with interest to all engineers; moreover, it is generally considered to be closely related to the status.

Many engineers do not have the gift of either oral or written expression; and, so far as the press and public are concerned, their worth remains unknown. The publicity bureau heretofore mentioned, could direct attention to meritorious

works designated and constructed by diffident and expressionless brothers of the profession, as well as to the works of members able and willing to recount their deeds with tongue and pen.

The modern engineer should be a good mixer and able to express an intelligent opinion upon many subjects outside the confines of his profession: in other words, engineers should not specialize to the extent of being crassly ignorant about everything not pertaining to their specialty.

The counterfeit engineer generally blows his own horn loud enough to cause the walls of another Jericho to fall flat, at the first blast. Moreover he is a good mixer, handshaker and purveyor of news of the day. This loud cackling and scratching convinces some people that an egg of wisdom, about the size of the fabled roc's, surmounts his spinal column —in many instances these tactics get him the job. Other engineers, in the counterfeit class, knowing that they do not know, hire competent assistants to do their engineering while they take the credit. This class is just as culpable and far more dangerous to the profession, than those ignorant of their ignorance.

Many engineers believe that neither the professional services of societies nor their individual members should be given gratis, even to their own cities or towns, except in a general way or under exceptional circumstances. Instances are on record of cities and towns having obtained valuable suggestions and plans by means which strongly suggested getting something for nothing. An editorial, "Another Bridge Engineering Competition," in a recent number of *Engineering News*, is an instance of this and concomitant evils. These unethical acts should be frowned upon by the profession.

A member of any national society should be accorded at all times and in all places, the full and active support of his society. Moreover this support should not be confined to ability alone, but should embrace probity and morals as well. Any member not living up to the standard required by his society and the ethics of the profession in general should, if proved guilty, be summarily expelled and a copy of the minutes of the proceedings sent to all the other societies: notice of the expulsion should appear in his society publication. However,

any accused member should be defended by his society in oral and written statements, until his guilt or innocence was established, and, if necessary, financial aid should be given: if the case was of national interest, national as well as local societies should render all possible aid.

Some engineers add to the general demoralization, regarding the status, by allowing their personal feelings to obscure their judgment of men. While everyone is more or less afflicted with this weakness, those whose ego is abnormally developed are the worst offenders. An engineer with this abnormality has some underling who is persona grata; this favored one is pushed forward, willy nilly, and immediately becomes a full fledged engineer (in his mind) as well as another "aggravation" and thorn in the professional flesh.

That the majority of engineers are paid inadequate salaries, for the responsibilities they have to assume, has become almost an axiom. Vast sums are expended under their direction, every dollar of which is expected to accomplish twice as much as a like amount spent by the ordinary mortal. The chief engineers of our railroads and industrial corporations could do much towards fixing the status of the engineer; but apparently their position causes their brain cells to undergo a change; for these men never appear to think of the profession either individually or collectively, and, about the large majority, of their engineer assistants, not at all.

That many engineers are deficient in English,—spelling, writing, composition, and grammar,—is proved time and again. The writer has had letters from young engineers fresh from college, whose penmanship, composition, and grammar would shame a lad of ten years. How could these engineers draw up the simplest specifications without leaving them as full of ambiguities, not to mention possible law suits, as a sieve is full of holes?

The various correspondence schools are fertile and prolific sources of "aggravation." These schools turn out a batch of half incubated engineers, every little while, on schedule time. Some of these are ambitious, intelligent, and deserve a better fate, but, other things being equal, they cannot compete with the graduates of reputable colleges; furthermore, they should not be encouraged in such competition.

OBITUARY.

CALVIN MILTON WOODWARD.

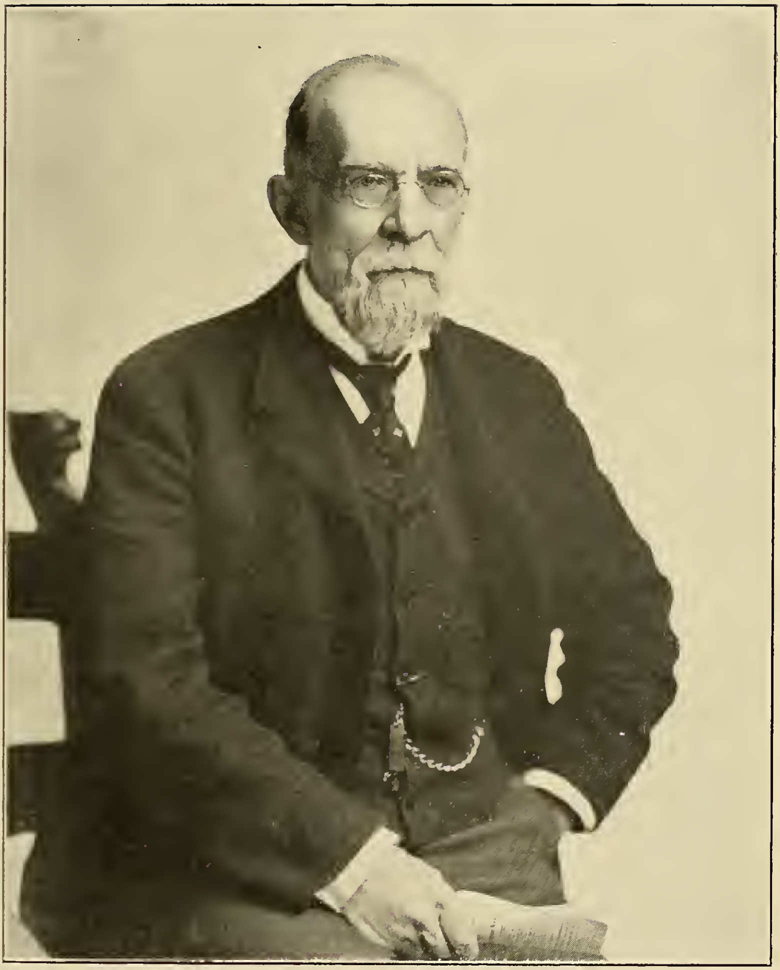
Honorary Member of the Engineers' Club of St. Louis.

Calvin Milton Woodward was born near Fitchburg, Mass., on August 25, 1837. He graduated from Harvard in 1860 with degree of A. B., and later on received the degree of A. M. "in course." Washington University conferred upon him the degree of LL. D. in 1905. The degree of LL. D. was conferred on him by the University of Wisconsin in 1908. He became a member of the Phi Beta Kappa on graduating from Harvard and later on in life was made a member of the Tau Beta Pi Chapter of the University of Illinois.

He was principal of the Brown High School, Newburyport, Mass., 1860-1865, but recruited a company and served as Captain, Company A, of the 48th Massachusetts Volunteers in 1862-1863.

Captain Woodward came to Washington University as Vice-President of the Smith Academy in 1865 and in addition to the duties of that position taught mathematics to the Freshman classes in the college at the time Chancellor Chauvenet was teaching higher mathematics. Due to the illness of the Chancellor Captain Woodward rapidly took over the teaching of Descriptive Geometry, Astronomy, Trigonometry, Surveying and Drawing. His advancement in the Faculty was rapid and in 1871 he was made Thayer Professor of Mathematics and Applied Mechanics and Dean of the Polytechnic School, known subsequently as the School of Engineering. He held the position of Dean until 1896. He was again Dean of the School of Engineering and Architecture from 1901 to 1910. From 1910 to the date of his death, January 12, 1914, he was Professor Emeritus, Washington University.

In 1880 the Manual Training School of the Washington University was opened. Professor Woodward, who originated and organized the School, took charge as Director. The school was a radical departure from time-honored educational lines, but was successful from the start. The original idea of manual training,



Strauss Photo

Calvin Milton Woodward
"A Teacher of Men"
1837-1914

in the opinion of the writer, occurred to Professor Woodward about 1873 or 1874, at which time the University began to furnish facilities for such of the students as felt inclined to avail themselves of the privilege.

Professor Woodward at various times conducted post-graduate classes, acting as student, companion and teacher, in studies of the work of Maxwell, Clausius and Hamilton.

Professor Woodward possessed to a remarkable degree the quality of mind necessary for successful teaching. He could see the difficulties of the student, as the student saw them, and also had the patience necessary to assist the student in overcoming personal difficulties and obstacles. The close personal contact of student and teacher, especially in the early days of small classes, was a powerful mental stimulus, to both student and teacher, the results of which have been apparent in the work and lasting friendship of Professor Woodward and his students.

Dr. Woodward's activities were not confined to the limits of teaching and directing in connection with the Washington University or the Manual Training School. An advocate and an exemplar of the "simple life" and a philosopher of the Hegelian School, his capacity for useful work seemed unlimited. He served as a member of the Board of Education of the City of St. Louis from 1877 to 1879 and as its President for the terms of 1899-1900 and 1903-1904. He was a member of the Board of Governors of the University of the State of Missouri during the years 1891-1897 and President of the Board from 1894 to 1897.

Dr. Woodward found time to assist in the advancement of various technical societies and contributed liberally to the papers and discussions presented. He was a Fellow of the American Association for the Advance of Science and President for the term of 1905-1906. He was President for a term of the Society for the Promotion of Engineering Education; a member of the St. Louis Academy of Science and its President in 1907-1908; President of the North Central Association of Colleges and Scientific Schools in 1909-1910.

Dr. Woodward took an active interest in the practice of Engineering and became a member of the St. Louis Engineers' Club in 1871; he was President in 1884 and an Honorary member at the time of his death. During his membership he contributed

to the Journal a number of valuable and instructive papers and discussions.

Dr. Woodward found time to act as an author and published a "History of the St. Louis Bridge" (Eads) in 1881, a book on "Manual Training in Engineering Education" in 1890, and a text book on "Rational and Applied Mechanics" in 1912.

The death of Professor Woodward deprived the members of our Club of a teacher, friend and companion. While we mourn his loss on our own behalf, we rejoice in the memory of a life nobly lived and a work well done.

For the Committee, by MINARD L. HOLMAN.

FUNERAL SERVICES, JANUARY 7, 1914

ADDRESS BY PROF. ALEX. S. LANGSDORF,*
Member of Engineers' Club of St. Louis.

Words of praise are but a feeble echo of the emotion that stirs us when there is taken from our familiar associations a tried and true and kindly friend. And one stands mute in the attempt to frame them, in the knowledge that nothing may here be said can add to the love and respect in which Calvin Milton Woodward was held by a host of people—people of all ages and station, attracted to him by reason of his vigorous personality, his kindling enthusiasm, his integrity, and high attainments. Yet it is fitting that there should be expressed, on behalf of Washington University, its Corporation, Faculty, students, and alumni, their lasting appreciation of Professor Woodward's long, loyal, and distinguished services, of the enthusiastic love and singleness of purpose that he puts into his work, and of the splendid results he achieved for this, the institution of his adoption. It is to me a very special privilege to pay this tribute in the name of the institution in whose service he spent his life, for to me it has been given to have been his student, his colleague, and his successor in office.

Professor Woodward came to Washington University nearly half a century ago, at a time when colleges and universities throughout the country had by no means attained their present standards. Indeed, it is plain from the records of that time that much of the work then offered in colleges is now a part of the

*Dean of School of Engineering, Washington University, St. Louis.

curricula of all well-organized high schools. As the University grew, and the aims and ideals of education developed, Professor Woodward grew likewise; more than that, he was one of the pioneers to whom was given the power to make realities of the visions that he saw. He did much to develop the technical department of the University, in the class-room and in the world outside, and ably represented it in the councils of the leading scientific and educational organizations of the nation. In conceiving and putting into practice the idea of manual training in secondary schools he made a contribution of great and permanent value to educational methods, and created for himself a leading place in educational history.

Just a little more than a year ago, in an address to the members of the Engineers' Club of St. Louis, and in the presence of many of his former students, he gave utterance to his belief that no epitaph could more highly honor him than the simple statement that he was a teacher of men; that he was a teacher of men, and a great one, will be cheerfully attested by each and all of the long line who have come under his guidance and who have gone out to do the world's work with the same fine spirit in which he did his own. His was the great gift of clear exposition, and the greater one of being able to inspire the minds that touched with his. Those who were so fortunate as to come under his instruction will not readily forget the energy of his presentations and withal the patience that he brought to bear. His contact with his students was close, and full of that personal interest which had its reward in the respectful love that all of his students bore for him.

No one, perhaps, will ever know the number of earnest young men to whom he stood for more than teacher; those, I mean, to whom he was a spiritual father, in the sense that through his influence and interest there was opened to them the opportunity of securing a higher education than would otherwise have been possible. Those who have not experienced such help can hardly understand its full meaning, nor the effect that such disinterested and kindly assistance is capable of producing. In work of this kind, known only to few, Professor Woodward did a full share.

Let us understand clearly that we have had to do with a big

man, whose place in educational history is permanent. We ought to rejoice that it was given him to lead a long and useful life, of large service to his community and State and nation, and of happiness to himself.

Funeral Services, January 7, 1914.

Abstract of Address by Mr. Ben Blewett.*

Here lies the body of him who for forty-one years was my friend. How shall I hope to utter that which will adequately express my feelings or that, even in some small measure, shall serve as consolation to those who bear most immediately the loss through his death?

He first touched my life, when as a youth, I entered the College. There are many recollections that impel me to speak in acknowledgment of my indebtedness to him as my instructor and to kindnesses extended to me in my early manhood, and it is difficult to withstand the impulse to speak of them. To me, however, is allotted the office of sketching the services he has rendered his city as a member of the Board of Education, and I must suppress the natural expressions of my personal gratitude that they may give place to consideration of the common indebtedness to him.

For sixteen years he was a member of the Board of Education of the City of St. Louis.

Too often our citizens fail to comprehend the importance of the duties of this office and seldom do they, as they should, hold in grateful regard the far reaching influence of a member who has performed those duties with devotion and comprehensive understanding. These men selected out by their fellowmen and invested with this trust are guardians of the city's most precious treasure.

* * * *

Twice was Professor Woodward called to this office of trustee of the education of the children of St. Louis at times of critical importance in the history of our schools. Once, in 1877, when the extended boundaries of the city brought under the care of the Board of Education the assimilation of the unrelated schools of added districts. * * * Again, in 1897, when an

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*Superintendent of Instruction, City of St. Louis.

aroused public consciousness awoke to the pressing necessity of changing the law governing school legislation and administration so that the schools might better meet the demands of rapidly developing changes in social conditions, Professor Woodward was the educator to whom leading men of the political parties turned as the one who might draw about him a group of men willing and competent to carry into effect the provisions under the new charter of the Board of Education that had just been granted by the General Assembly.

Under this charter the schools entered upon a new life. All who keep in touch with the public interests know the great interval that separates the plane on which this institution stood in 1897 and that to which it had advanced by 1911.

In the improvement of the buildings, in the provision and selection of text-books and supplies, in the adaptation of the curriculum to meet modern conditions, in the plans for improved preparation of teachers and for aiding and stimulating their continued development, in their advancement to a more adequate compensation, and in arousing public opinion to ready willingness to pay in taxes the cost of this expenditure for the improved education of the children and youth of our city; in all of these things through all of these years may be easily traced the influence of Professor Woodward. It touched the life of every family in this city and touched it for good.

Funeral Services, January 7, 1914.

Address by W. A. Layman,*

Member of Engineers' Club of St. Louis.

Many men of great achievement live beautiful lives of close and helpful comradeship with associates of their own generation, but few welcome to the fireside glow of their hearts, as did Professor Woodward, an unbroken line of fellowship, down into the very ranks of childhood.

Pre-eminenetly was he the friend of young man on the threshold of professional life. He did not simulate an interest and confidence in them. He believed in them with a paternal faith and cordial enthusiasm, rare indeed in older men. He discov-

*President and General Manager, Wagner Electric Co.

ered to them energies they knew not of themselves, and inspired them to ambitions broadening greatly their possibilities of achievement.

I cannot speak to-day as one of his class-room boys, for I was not a student under him, but in all sincerity I once said to him, that were I, at the moment, to voice a single great regret as to my college days, it would be that I had not the rich experience of student life under him. I do enjoy, however, a wide acquaintance among young men who have the legacy of a professional foundation of his building. Neither time nor distance has dimmed his inspiration of their professional lives nor intervened a barrier to a personal relationship, beautiful to contemplate. Young men, as they take up the real burdens of life, doubly honor and love the strong men of mature years who generously interrupt the activities of their own invaluable careers as did he, to give them a guiding hand. Was it not a happy recompense to him that he knew throughout his later active years, of the loyal affection of the ever-growing army of "his boys?"

In two ways he cemented his fellowship with "his boys." He gave freely of his time and counsel when they needed help, and he went to them for discussion of and co-operation in his own plans and problems. So widely diversified were the activities of his life that his working arrangements with the host of his young men supporters were of a constantly widening character.

I could speak at length in general terms of his kindliness, enthusiasm, optimism, diligence, and other great and good qualities, but there are some specific things I perfer to mention, which illustrate the usefulness of his example to the young men of the community, in and for whom he manifested so often his great faith and affection.

He specialized professionally and advocated specialization in this era of rapid progress. In individual work he preferred to be known, I believe, as a teacher of applied mechanics, and the crowning accomplishment of his specialized work was the gathering together and publication in his last years of his book on this subject. Yet, great specialist as he was, pre-eminently was he a man of great activity in all the fields of social and industrial progress of the community.

As an engineer and scientist, he exchanged freely and always

with his associates in these fields, the fruits of his professional work. He supported actively, both national and local societies in these professions and frequently contributed to the published proceedings of many scientific bodies. He sought opportunities to give freely to the public through these channels, the best he had within him, rather than withhold this ability for personal and selfish aggrandisement.

As the father of the Saint Louis Manual Training School, he might have been excused for selfishly safeguarding it against the inroads of other institutions in this field and yet he was big enough to go further, with great enthusiasm and in all possible ways, the introduction of the manual and vocational training idea into all other possible educational channels of the city. He was interested in the achievement of the largest good, rather than the selfish protection of a physical monument to himself.

He sought in all possible ways to lend his professional services gratuitously to the City of Saint Louis. In the study of our problems of sewage disposition, water supply, street car transportation, bridge construction, etc., he contributed his best judgment and power of analysis without partisanship and without thought of selfish elevation.

He gave freely of his own valued time to the promotion of our great system of public schools. He held this as another phase of his duty to the general public. Who can truly measure his great service in this direction—coming down through the School Board from the top, and up through the thousands of children who knew him, from the bottom?

He opened wide the doors of his study at any and all times to further the good work of the Civic League and all other public organizations of merit.

In a spirit of pure devotion to the public welfare, he followed closely all city legislative matters, and contributed freely of his energies in the form of newspaper discussion or addresses at public hearings at the City Hall, whenever he deemed he could be of service in this direction.

He was a great lover of healthful sport as a means of physical and mental recuperation, and believed in being as efficient as possible at play as in work.

He subordinated always the love of mere money to living a life of broad usefulness to this community and to the world in general.

His home and church life was a most perfect example to the young man with a blossoming family circle of his own.

In brief, his was a "balanced" life, and as a "balanced blood" gives fullness and the glow of perfect health to the body, so will his balanced living mark for us all, not only a happier and fuller course through life, but an easier and a better one.

There are many kinds of great men to whom we owe praise and gratitude. Some serve us briefly through great periods of public emotion when judgment, for the moment, turns aside. Some guide us through misfortunes that temporarily beset us. Some save us from the uncontrollable bursts of our own passions, and many, for short intervals and in limited ways, come helpfully into our lives.

But who is greater or better than the man who helps us daily in the problems of our lives, stands beside us as we strive to climb to higher levels, sees ahead the dangers of our course and warns us from them, always giving, never seeking—such a man was Professor Woodward, for whom there shall glow in all our hearts, until we too pass into the infinite future, the abiding memory of a generous and unblemished love.

A. S. PETERS,
President Utah Society of Engineers.

G. Alexander Wright,

President of the Technical Society of the Pacific Coast.

ASSOCIATION ENGINEERING SOCIETIES

ORGANIZED 1881.

Vol. 52. APRIL, 1914. No. 4

EDITORIAL.

On account of the withdrawal of the Detroit Engineering Society from the Association on March 31, Mr. Gardner S. Williams, who was a member of that society, submitted his resignation as Chairman of the Board of Managers to take effect on the same date.

The Association is deeply indebted to Mr. Williams for his six years of faithful service. The Members of the Board are so widely scattered that it is impracticable to have meetings except on rare occasions and many matters are referred to the Chairman of which the average member hears nothing. In the course of six years this has undoubtedly taken up a very large amount of his time, all if which has been given cheerfully and gratuitously.

The report of Chairman Williams for the year 1913 is published in this issue, but a financial report from the former Secretary, Mr. Fred Brooks, was received too late for publication in this number.

The election of a new Chairman is now under way in accordance with the Rules of the Board of Managers. Because of the suggestion of the retiring Chairman, that the business

of the Association could be carried on more expeditiously and the work of the Secretary facilitated by having the Chairman and Secretary located in the same city, the St. Louis Members of the Board of Managers have nominated Mr. John W. Woermann for the position. Other nominations are in order, but up to the time of going to press none additional have been received.

Amendments to the Rules of the Board of Managers have just been carried whereby, instead of furnishing gratis to each author of a paper who requests it, 50 reprints of his paper, he will hereafter be furnished with 50 copies of the Journal. Each person taking a prominent part in the discussion of any paper is now entitled to 5 to 10 copies gratis, according to the importance of his discussion, provided his discussion is submitted in writing. Additional copies of the Journal will be furnished to authors or to those taking part in the discussion at 10 cents each. Provided in each case that the Secretary of the Association is notified in advance of the number of extra copies desired.

These changes were made in the interest of economy, as it was found cheaper to furnish a member with 50 extra copies of the Journal than to prepare 50 reprints. The distribution of extra copies of the Journal also increases the "circulation," which has a value in soliciting advertising. The change is therefore to the advantage of the Association without any disadvantage to the individual members. Authors who for any reason desire reprints will be supplied by the Secretary at actual cost.

The Secretary has been carrying on a correspondence with officers and members of engineering societies in a number of cities with a view to having such societies join the Association. The indications in several instances indicate that the result will be favorable, but it would be premature to make any definite announcement. The Secretary solicits the cooperation of all the members in the Association in this campaign, particularly in suggesting to him the names of additional engineering societies which might consider such a proposition favorably.

THE DEVELOPMENT OF OUR RADIUM BEARING ORES.

By L. O. Howard.*

[Read before the Utah Society of Engineers, February 20, 1914.]

Through discussion in technical and popular magazines, doubtless propagated to a great extent by the publicity furnished by the federal bureau of mines and the recent hearings before congressional committees on the question of withdrawal or control of the radium bearing lands as yet unlocated on the public domain, radium has become a matter of much interest to layman as well as scientist. It has been the inevitable result of so much publicity that the public has been grossly misinformed on the subject, both as to the condition of radium therapeutics and with regard to the extent and value of our ores. Concerning our own Utah deposits little has been published of a reliable nature and the bulk of the people are unaware of the position that Utah has to-day in the furnishing of ore for radium production.

It is not my intention to-night to go into the subject in all its ramifications, but merely to give you some idea of the difficulties and disappointments, troubles and tribulations, through which those who have been engaged in the work of winning the radium from our ores have passed, and to show you in some respect the importance of our own State in furnishing some of the raw material for this new industry.

In the preface to the recent bulletin of the federal bureau of mines, in referring to certain investigations that the bureau has made, it is stated that:—

"As a result of this investigation it has been definitely shown that, although the Austrian government has conserved its own resources of uranium and radium by purchasing the Joachimsthal mines and by carefully supervising pitchblende production, the deposits of the radium-bearing minerals in the United States are being rapidly depleted by wasteful exploitation, chiefly for the benefit of foreign markets.

"Seemingly the country has been quite unaware of the extent to which radium ores have been sent abroad. Investi-

*Mining Engineer and Associate Editor of the Salt Lake Mining Review.


SKETCH MAP OF
UTAH
SCALE IN MILES
Carnotite Deposits
Shown thus: ●
UTAH-IDAHO STATE LINE
UTAH-WYOMING STATE LINE
UTAH-NEVADA STATE LINE
UTAH-COLORADO STATE LINE
UTAH-ARIZONA STATE LINE
CACHE
RICH
SUMMIT
WASATCH
UINTA
TOOELE
GREAT SALT LAKE DESERT
JUAB
MILLARD
SAN PETE
EMERY
CARBON
GRAND
SEVIER
BEAVER
PIUTE
WAYNE
IRON
GARFIELD
SAN JUAN
WASHINGTON
KANE
NAVAJO INDIAN RESERVATION

gation has developed the fact that during the year 1912 carnotite ores carrying 28.8 tons of uranium oxide were produced and that practically the entire amount was exported. The major part of the ore carried between two and three per cent of U_3O_8, as it appears that no ore carrying less than two per cent can at the present prices bear the cost of transportation. This means that 8.8 grams of radium chloride, or an equivalent, 11.43 grams of radium bromide, will be obtained from the ore shipped from this country in 1912. Only one American company has been preparing radium salts of a high degree of radio-activity and its product has only recent-

Camp Vanura, Looking Toward Green River.

ly been offered for sale. The American ores exported were purchased for their radium content. It is improbable that all of the ores exported are now represented by finished product, but the 1912 production of radium from American ores cannot have been less than the quantity mentioned, for uranium was being shipped abroad in almost equal quantities in 1911, and is still being sold for future manufacture. It can probably be definitely stated that in 1912 there was obtained from American ores nearly two and one-half times as much radium as from all other sources combined."

For 1913, Frank L. Hess of the United States Geological Survey states that ores carrying an equivalent of 38 tons U_3O_8 were mined, equivalent to 8.79 grams of metallic radium. When you bear in mind that three to four grams of radium per year was a large output three years ago, and was about

the total of the world's production at that time, the present position of the United States is clearly emphasized.

The impression has been general that we had to look to Europe for our radium; that we did not know how to make it in this country; that the well-known ability of foreign

Showing Different Stages of Mining.

chemists had placed America in a humiliating position. It is, however, no longer necessary to depend on a foreign supply. We are to-day making radium in our own plants in comparatively large quantities.

In connection with the radium in our ores there are two other metals of considerable importance,—uranium and vanadium. Before considering the more important and more interesting radium, let us pause for a brief consideration of these two.

Vanadium.

Vanadium is not found free in nature. It was first mistaken by Del Rio in the lead ores of Zimapan, Mexico, for some form of the metal chromium and was given the name erythronium. In 1830 Von Sefstrom discovered the metal in certain Swedish iron ores and named it in honor of the Swedish god Vanadis. It was not until several years later that Sir Henry Roscoe isolated it. Vanadium has a specific gravity of 5.5 and is silvery white in color. Although its pres-

ence in Swedish iron ore was known as far back as 1830, it was not until 1896 that Choubley, Helouis, and others in France gave to the world the results of their researches on the influence of vanadium on iron and steel. Professor Arnold of Sheffield, England, later showed the importance of limiting the vanadium in steel to 0.6 per cent. The growth of the vanadium steel industry has been so rapid that all leading steel makers now produce it.

Vanadium increases the tensile strength, elastic limit and torsional strength of steel and imparts great wearing qualities. It acts largely as a scavenger in removing oxygen and nitrogen from steel, and hinders segregation by promoting the uniform distribution of the carbon, manganese and silicon. It is used in the form of ferro-vanadium, and is dropped into the molten steel before pouring. Vanadium steel finds its greatest use where toughness and torsional strength are required, as in gun-barrels and stands, boiler plates, tubes, piston rods, gears, tires, shafts, bolts and automobile parts. The usual per cent of vanadium is from 0.1 to 0.4. A small amount of it replaces a large amount of tungsten in making high-speed tool steel.

A 300-Foot Cut on the Pittston Claim.

It also finds some use in making analine dyes and in tinting glass.

Uranium.

Uranium was first discovered in its oxide form by

Klaproth in 1789 in pitchblende from Joachimsthal, Bohemia, and named after Herschel's discovery of the planet Uranus. The free metal was first isolated by Peliglot in 1842. The metal is fairly malleable, looks like nickel, rapidly oxidizes in the air and is of but academic interest. Pitchblende, the

A Productive Opening on the Melrose.

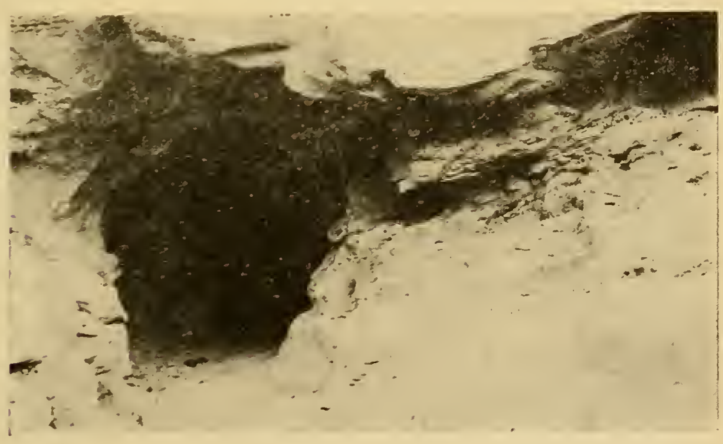
mineral in which the radio-active substances were first found, was known to occur at Joachimsthal as far back as 1727.

Radium.

The discovery of the property of radio-activity was largely accidental. In 1896 Becquerel was conducting experiments to determine the effect of the fluorescence of uranyl potassium sulphate on sensitized plates enclosed in light proof covers. Fluorescence, in plain terms, is a peculiar property imparted to certain substances when they are exposed to sunlight which causes them to afterwards glow in the dark. Becquerel placed his covered plate in a drawer and put the uranium salt upon it, to await a sunshiny day before exposing the salt. A few days later he started the experiments he had in mind, substituting a new plate. When the old plate was developed he was very much surprised to find it had been strongly affected by the salt, which had not been exposed to the sunlight. This

result started a new train of investigation, which convinced Becquerel that he had discovered a new property of matter and that this property was peculiar to uranium. Omitting for the present discussion of the property of radio-activity let us trace rapidly the development of the knowledge concerning it which led to the discovery of still other elements possessing this property.

Schmidt and Curie working independently found that thorium was also radio-active. Madame Curie ascertained that there were minerals more radio-active than uranium, and that if uranium were separated from these minerals it had the normal activity, thus leading to the conclusion that there was some element or substance in the residue that possessed a high degree of activity. A chemical investigation of pitchblende from Joachimsthal showed that still another radio-active substance was separated with the bismuth, to which the name of polonium was given in honor of her native land Poland. Continuing the work Madame Curie and her associates found another element, which was separated with barium,

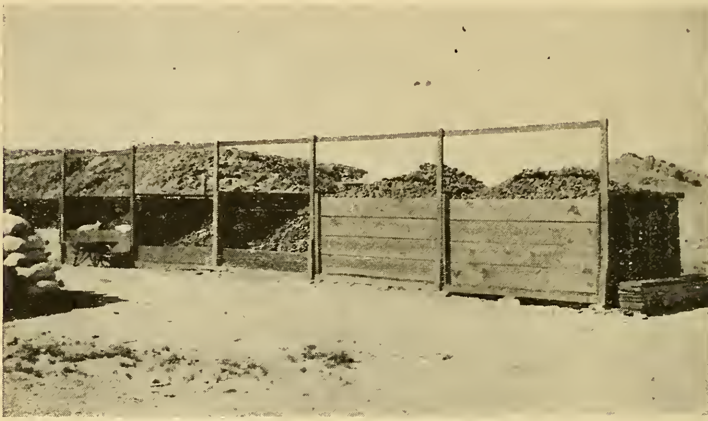


Two Feet of Ore at Tunnel Portal.

which, when brought to a state of concentration, was several million times as active as uranium. This was radium. Debierne afterwards found a fifth radio-active substance, actinium, and in 1905 Boltwood isolated the metal ionium. Development in the knowledge of radio-activity has been rapid since that time.

Ores of Radium and Associated Metals

Four principal economic minerals containing uranium, vanadium or radium may be mentioned. Patronite is a sulphide of vanadium, containing iron, sulphur, silica, molybdenum, nickel and vanadium. It is black to greyish black, con-



Carnotite Ore Ready for Sampling.

taining as a mineral 18 to 25 per cent vanadium, as an ore 13 to 15 per cent vanadium, is found in Peru and mined by the American Vanadium Company at Minasraga, Peru, and brought to this country for the manufacture of ferro-vanadium. This mineral contains no uranium or radium.

Roescoelite is a vanadium mica, brown to greenish brown, and greenish, containing 21 to 29 per cent vanadium, when pure, and occurring in California, Colorado and Utah and mined only in Colorado. Mined only for vanadium, the ore forms the basis of operations for the Primos Chemical Company, which has a plant at Vanadium, Colorado, and a refinery at Primos, Pennsylvania. Vanadate of iron is produced at Vanadium, and shipped to Pennsylvania for the manufacture of ferro-vanadium.

Pitchblende, up till recently the main source of radium and the mineral in which it was first discovered, is an oxide of uranium with the rare earths, and lead, calcium, iron, bismuth, manganese, copper, silicon and aluminum, has a dull sub-metallic lustre, conchoidal fracture, is brittle, dark brown

to black in color, with some varieties olive green and greyish; it has a hardness of 5.5 and a specific gravity, when crystalized, of 9 to 9.75 and of 6.4 and higher when massive. It contains from 30 to 80 per cent uranium. It is found in several localities in Connecticut, North Carolina, Texas, South Dakota, in some abundance near Central City, Colorado, in Quebec, Austria, Norway, Spain, East Africa, Mexico, and in the old Cornish tin mines.

The mines at Joachimsthal, Austria, have been worked since 1517, mainly for silver until 1545, and later for bismuth and cobalt, and during the past two decades for uranium, the salts of which were used to color glass yellow and give it a peculiar opalescent tint. In ceramics beautiful fireproof tints of yellow, orange and black are produced.

In the vicinity of Central City, Colorado, are several mines, which have produced some pitchblende from narrow veins, ¼ inch to 4 inches thick, with occasional small pockets. The veins lie in schistose granite and sometimes in porphyry.

Carnotite Ore Ready for Shipping.

Carnotite.

The carnotite ores of Colorado and Utah early attracted attention, the bright yellow substance being said to have been used by the Navajo and Ute Indians for pigments, and the

copper ore in some of the carnotite pockets attracted the white men.

The mineral has been defined as a uranyl potassium vanadate, containing barium and calcium; it appears to be amorphus, but under the microscope shows flaky crystals. It is in color canary yellow and usually occurs mixed with sand and as a coating on sandstone grains. The composition varies widely, the pure mineral carrying 20-54 per cent U_3O_8, 7 to 18 per cent V_2O_5, 5 to 6.5 per cent potash, 0.3 to 2.8 per cent baryta, 1.6 to 3.3 lime, and traces of lead, aluminum, iron, arsenic and phosphorous. The amount of radium in carnotite has not been found to be directly proportional to the uranium present. In the geologically older minerals it has been determined that there is a definite ratio between the amount of radium and the amount of uranium, and when this ratio is attained these elements are in equilibrium with each other. This ratio is one gram of radium per 3,000 kilos of uranium or one part in three million. There is considerable variation, however, in the relative amounts of uranium and radium in different specimens of carnotite.

It is said that Andrew J. Talbert first mined some of the carnotite ore of Colorado and shipped it to Leadville, where assays showed $5 in gold per ton, rather an unusual carnotite ore. In 1896 George Kimball and Thomas Logan sent specimens to the Smithsonian Instiution at Washington, and the presence of uranium was determined. About ten tons of this ore was shipped to Denver and sold for $2,700 on account of the uranium content.

The ore was known even earlier in Utah. About 1878 Professor Newbury detected uranium oxide in high grade silver ore from the Buckeye reef, Silver Reef district. Don Maguire of Ogden exhibited some of this carnotite at Chicago in 1893.

In 1889 Messrs. Poulot and Voilleque of Paris and Denver also found the material in western Montrose County, Colorado, and sent some of it to L. Friedel and E. Cumenge at Paris, who first described the mineral in a paper presented to the Academy of Science in 1889.

The name has been ascribed to two sources, one statement being that it was named in honor of the chemist, Adolphe Carnot, the other that it was named in honor of the president of France.

Early Attempts to Mill Carnotite.

In 1900, Poulot built a mill at Cashin, Colorado, to treat the ore for the recovery of the uranium and treated about 130 tons. This plant then became the nucleus of a larger one

Ore Teams Leaving Camp.

erected in McIntyre canyon. The Rare Metals Mining & Milling Company was later organized to operate the plant. The ore was crushed through 40 mesh, and water and sulphuric acid added to the ore in vats, and the mixture was paddled by hand with wooden paddles until the carnotite dissolved. The solution was decanted and precipitated with sodium carbonate. After settling the clear barren liquor was run off and the greenish slimes and precipitate were run to an open filter. After drying this precipitate contained about 12 per cent U_3O_8, and about the same amount of vanadium oxide. About 300 tons of ore were treated with poor results.

The Western Refining Company afterwards conducted some experiments on the ore and in 1905 the Dolores Refining Company put up rather a complete mill about a mile from the old Rare Metals plants, anl spent about $50,000 in a vain attempt to treat the ore. I am indebted to Alfred Hale, a Denver engineer now with the Primos Chemical Company, for the information as to the early plants. He also carried out some careful experiments on the ore after the Dolores

company failed, but found that the losses were tremendous and the processes unprofitable.

In 1910, the General Vanadium Company, a subsidiary of the International Vanadium Company of Liverpool, and the Standard Chemical Company of Pittsburg, started mining the carnotite ores of Colorado and the former shipped the ore abroad where radium as well as uranium and vanadium was extracted from the ore. In 1913 the Standard commenced operations in its own plant at Pittsburg. It is now known that the carnotite ores constitute the world's principal radium resources.

Before taking up the Utah deposits, the following localities may be mentioned where carnotite occurs in Colorado:

On Skull Creek, near Hayden, Routt County.

On Coal Creek, 18 miles east of Meeker, Rio Blanco County.

Hydraulic, Naturita, and Uranium in Montrose County.

McIntrye Canyon, on the Dolores River and at Cedar, Montrose County.

The chief region, and the principal scene of mining operations lies between the San Miguel River, the Dolores River and Bull Canyon, in the counties of Montrose, San Miguel and Dolores, the richest being in Paradox valley along the Rio Dolores in Montrose County.

Carnotite in Utah.

In Utah the ores of vanadium, uranium and radium are found in several localities in the eastern section. Briefly these localities may be stated as follows:

In Uintah County, near Independence and extending into Wasatch County, and on Red Creek.

In Grand County, at Moab, Dewey, Richardson, and sixteen miles southeast of Thompson's.

In Emery County, near the town of Green River and at Table Mountain, 45 miles southeast of Green River.

In San Juan County carnotite has been reported from the vicinity of Monticello, near Dry Canyon, and from Copper Canyon, in the southwest portion of the county.

In Kane County, minerals similar to those at Richardson are found near Pareah.

In Wayne County, in the vicinity of Hanksville and Fruita

and in the Henry mountains, several carnotite claims have been located.

In Garfield County, along its eastern portion.

Low grade ore has been shipped from below Thompson's, from Dewey, Richardson and Moab, and the Standard Chemical recently took over a group of seventeen claims near Hanksville. From Green River the largest shipments have been made.

The Green River deposits lie on the south and east of the San Rafael swell. These are the deposits with which I am most familiar, and which I will describe in some detail, as they are the basis of operations of the Radium Company of America, which now has the largest radium plant in the world in operation at Sellersville, Pennsylvania. Before doing so, however, let me refer to the early history of the Utah deposits.

Early History in Utah.

The deposits at Richardson were the first to gain any prominence. They are said to have been discovered in May, 1898, by Welsh and to have been prospected by Lofftus. In 1900, Stephen T. Lockwood of Buffalo, New York, secured samples of the ore and in 1902, he published in the Engineering & Mining Journal of September 27, the first radiographs from American carnotite. In June, 1902, he secured 500 pounds of the ore and as a result of experimental work a plant was constructed in October, 1903, by the Rare Metals Reduction Company to produce radium, and in April, 1904, a 17-ton shipment was sent to Buffalo, where it is said a fair extraction was made, but the ore proved too low-grade for profitable operations.

In 1912 a shipment of twenty-four tons was made from Richardson, which ran only 0.5 per cent uranium oxide.

At Table Mountain, Beebe and Browning started prospecting work on their claims as early as 1903, and I have found in the Green River field location notices which were put up about the same time. Fifteen tons were early shipped to Germany from the Green River field, but only sporadic prospecting and practically no development was done here until early in 1912, when a Philadelphia syndicate headed by

Angus Cameron started operations in earnest. This syndicate has since developed into the Radium Company of America.

The Country About the San Rafael Swell.

The San Rafael swell is an oval-shaped elevation, some forty miles long, and ten or twenty wide, probably underlain by a laccolith which has lifted this section and tilted the surrounding sedimentary beds. Seen at a distance from the east, or broadside on, the edge of the swell has the appearance of saw teeth, as it rises abruptly from an apparently level plain. Back of Green River station, where the D. & R. C. Railway crosses the Green river, are the flat lying Book Cliffs. Looking to the west from the railroad the country appears flat, but is in reality cut into numerous small canyons and washes. The swell appears as a very prominent feature of the landscape.

The San Rafael river flows across the northern end of the swell a little south of east, and cuts through a high wall to a deep valley following the border of the swell and turns south toward its junction with the Green River. The swell here has an elevation of about 7,500 feet.

To the east of this broad valley and rising three or four hundred feet are what are known locally and now generally as the San Rafael reefs, an uptilted series of shales, conglomerates, gypsum beds and sandstones, rising precipitously from the valley and dipping gently to the southeast until they merge with the rolling plains extending to the Book Cliffs.

This country is practically a desert, but some ranches are established along the San Rafael river. The climate is arid with occasional heavy rains in the spring months. Snow does not ordinarily interfere seriously with midwinter operations. There is no timber except sparse growths of cottonwood along the river, and little except desert vegetation.

The property of the Radium Company of America is situated in T. 21 and 22 S., R. 14 E., Salt Lake B. & M., at an elevation of 4,500 feet. A good wagon road leads to the town of Green River, twelve miles to the east.

The country in the vicinity of the claims is rugged, consisting of the sedimentary series above referred to, and cut by some north and south erosion, resulting in the deep valley between the swell and the reefs and in numerous washes in

little valleys between the successive hogbacks. The reefs have also been cut at right angles by numerous narrow gulches with steep sides and bottoms draining to the southeast. This condition makes for many exposures of ore but rather increases the difficulty of hauling ore to camp, and has resulted in the undoubted removal of considerable ore.

Camp Vanura Established.

On January 2, 1912, Camp Vanura was established about one and one-half miles to the north of the point where the San Rafael river cuts through the swell, which point is shown on the maps as Tidwell. The conditions surrounding operations at this point are good. Supplies or commissary and mining can be easily secured from Salt Lake and emergency orders can be filled from a fair stock carried by local merchants. Water is scarce, Cottonwood Springs, four and one-half miles to the northwest, supplying pure water, but the rough topography makes the haul too long and water is best secured from Green River, being hauled out at a cost of $2 per 8-barrel tank on return trips of ore-teams. A concrete reservoir was constructed at the camp and covered with planks, concrete and soil, and fresh, clear cool water is always available except for a short time after filling.

Labor is plentiful at Green River, and with proper care a good force of steady workers can be secured. Naturally they all have to be taught how to sort these ores, but the men are of an intelligent class easily instructed. Wages are $2.50 and board per 8-hour shift.

Explosives are expensive on account of high freight rates, 40 per cent dynamite costing laid down at Green River, $16.70 per 100 pounds, fuse 0.45 cents per 100 feet, and No. 5X blasting caps, $7.50 per 1,000. Ordinary undressed Oregon fir of poor quality costs $27 per M., and for any but temporary uses lumber of better quality and costing $35 to $40 per M. must be used.

Supplies are hauled to camp on empty ore-teams for $2 a load of 3,000 pounds, and ore is hauled on contract for $4.50 per ton. The cheapness of ore haulage places these deposits in the front rank for low costs, for the cheapest haul in Colo-

rado is about $17.50 per ton, and most operators exceed this figure.

Beginning of Work at Camp Vanura.

Men were sent out from Green River on the 2nd of January, and pitched the camp with great difficulty, with the thermometer 20 degrees below zero and a gale blowing. The first tent was pitched after nightfall, and the men retired to a cold and cheerless night. Fortunately I missed these pleasures, arriving from the east on the 11th, when the weather had moderated and conditions were excellent. A cook and dining tent, two bunk tents and the mine office had been erected at that time. The remaining necessary construction work was soon finished, laboratory equipment installed and mining was begun with three miners on the 19th.

The camp was soon comfortably equipped with commodious offices, laboratory and sleeping quarters for the operating heads, comfortable tents for the men, with board floors and walls, kitchen and dining tents, a well stocked commissary and store houses for supplies, tools and explosives, and complete equipment for surface mining.

The company's claims extend along the reef for four and one-half miles, covering the known ore horizon.

Ore Occurrence.

The ore occurs in a sedimentary formation, which is thought to belong to the Flaming Gorge formation of Jurassic age, and may be correlated to the La Plata sandstones in which the Colorado ores occur. The beds have suffered considerable erosion, but when this has not been too deep, a thin bed of quartzite lies on the highest portions. Beneath this is a medium coarse to fine conglomerate. Both tend to weather to dark colors, the quartzite to black and the conglomerate to dark brown. Beneath the conglomerate lies a coarse-grained white sandstone, underlain by a thin seam of green shale. The sandstone shows much cross-bedding.

The ore is found principally as an impregnation of the sandstone and lies in any part of the same near the surface, sometimes immediately underneath the conglomerate, at others on top of the shale. The conglomerate is sometimes the source of valuable ore and occasionally the quartzite shows

a slight mineralization. The principal mineral is the canary yellow carnotite, whose color is often obscured, and a variety of earthy minerals usually accompany it. The various minerals present a startling array of colors: black, all shades of green, yellow, blood red. The black is sometimes glossy, like coal, sometimes talcy, and sometimes dull earthy. These are usually the best grades of ore. The browns are harder and more compact and lower in grade. The yellows are typically of a more sandy nature and may or may not be of high grade, depending on the amount of the rich yellow color. The greens vary from earthy to hard compact, and are variable in grade. Sometimes the ore exhibits a distinct banding most pronounced in the greenish ores.

During the time in which I was in charge of development, the ore was found in pockets in sandstone, of a thickness of a few inches up to three feet, and often yielding from 30 to 50 tons each. The pockets are sometimes elongated in the direction of the strike of the formation, and may or may not be connected by narrow seams of ore or iron-stained rock. In places there is no present connection between pockets. This is especially so in many of the gulches where erosion may have removed the former connections.

Occasionally a small body of ore will be found in a pure white sandstone and having no visible connection whatever with other ore. Occasionally, also, pockets are found to overlie each other vertically, with no apparent connection between them. The thin portion of one pocket may lie over the thick portion of another, or both may have their thickest proportion in the same vertical plane. Most of these pockets which outcrop under a few inches of soil pinch out to an inch or so or entirely at a depth of twenty to thirty feet on the dip, although some ore has been found to extend deeper, while the limit of other bodies has not yet been determined.

The ore was evidently formed by the precipitation of the minerals from solution by carbonaceous matter or iron or both, and possibly the lime which cements the sandstone may have had an influence. The ore is found largely in connection with iron-stained rocks, and about the circumference of petrified trees, penetrating to the heart of the tree to a lesser degree. Some of this ore has been mined from trees which

were as much as thirty feet long and two feet in diameter. In cases isolated trees are surrounded by a thin coating of rich ore and nothing but barren white sandstone about them. In the case of one tree in particular, rock was broken for about four feet beyond both ends, to the sides and below, with no indications of further ore.

The nature and source of the pregnant solutions, the precipitation of which caused the deposits, has not been determined. It is possible that hot solution associated with the uplift of the sedimentaries, and with the igneous rocks causing this uplift, may have leached the sandstone beds and redeposited the mineral. The sandstones are known to contain the mineral in small amounts which could have supplied the highly solvent solutions with mineral, which was again precipitated when favorable precipitants were reached. Or surface waters may have been the agents of solution and re-deposition. Or the minerals may have come from depth, which is the least likely. As far as I know no one has been rash enough to pronounce any definite conclusion as to the origin of these deposits.

Mining the Ore.

At the beginning of operations the ore was practically all mined in open cuts started on outcrops. Where possible, the ground was first opened up along the strike for a distance of about twenty feet, by a trench three to five feet wide. With one side as a face, the cut was advanced down the dip by blasting into the cut already made, until the ore-streak became too thin or the overburden too great to pay to go further under the conditions then existing, inasmuch as it was intended to mine as little as possible of material that could not be profitably shipped, since it was hoped to make the mine pay its own way and provide the funds for reduction works, which it might be advisable to erect to treat the lower grade ores locally. Many of these openings will undoubtedly show more ore, when work is conducted purely for exploratory purposes.

All holes were drilled by hand, and the rock broken with 40 per cent dynamite. The waste was wheeled to nearby dumps, the second class, or possible ore, being put by itself on other dumps, and the cobbed and sorted first-class prepared

for sacking. It was found that a man broke about 900 pounds of first-class ore per shift of eight hours, drilling about five feet of hole per ton of ore. As sorted at that time, there was moved per ton of first-class, about seven tons of waste and one-half ton of second-class. Occasionally the ore was best mined by tunneling and stoping, but it is usually found to be cheaper in most cases to strip the surface down to ore.

For the four months ending April 30, 1912, including all money expended for establishing camp, the first cost of mining and laboratory equipment, and, in fact, including all expenditures to mine and prepare the ore for shipping from the camp, 302 tons of ore was mined at a cost of $20.27 per ton. The April costs were about $18 per ton, and this figure could perhaps have been still further reduced. For actual mining, including development, the cost for labor, supplies and explosives averaged about $7 per ton, and it was found almost impossible to reduce this cost.

Handling the Ore at Camp Vanura.

During the pioneer stage of operations it was necessary to do very careful sampling in order to have a check on shipments. Owing to the nature of the ore it is practically impossible to sample the ore in place, and as a guide to mining it was necessary to select certain well-defined specimens, of all grades, preserve one-half and have the remainder analyzed. The analyses were attached to the specimens and a pretty reliable means was had of controlling the sorting. To-day this is the only method used at these mines, the real sampling being done on the carload shipments at destination, or en route.

As mined the first-class was sorted, cobbed, and placed at once in canvas sacks, which held conveniently about eighty pounds when not tied. Twenty of these sacks made a good load for a 2-horse team over the rough country to camp, and eight trips a day were possible, depending on the location of the working place and its accessibility. The camp, it must be remembered, is situated conveniently for wagon haulage to the railroad. At many points in Colorado the work of getting the ore to wagon haul must be done by pack trains. Upon reaching camp the ore is dumped into one of six 12-ton bins, lots from different working places being kept separate. In the ordinary routine these bins, which are flat-bottomed,

are not boarded up, but the front is left open for ease in shoveling, the bins resting directly on the ground. The capacity is somewhat less in this case.

At convenience sampling is begun. The ore is re-sacked by shoveling, taking every tenth shovel as a sample. Ore at this stage should have a maximum diameter of four inches, and the men are instructed to break all pieces larger than three or four inches before sacking. The re-sacked ore is weighed bag by bag and tagged with a lot number and weight, and placed on a platform for shipping. Even here advantage was taken of little economies. Sacks were tied instead of sewed, and the largest lot was left untagged, and six or seven sacks weighed at a time. This lot would be the first to go into a car, and the remainder of the shipment would be made up of other lots, which could be split in any way desired to get the proper weight and analysis. By this system it was possible to calculate pretty closely the analysis of the carload lot.

The above procedure assumes that the selection of ore has been right at the working place. Should subsequent analysis show the ore to be too low grade to go forward at that time it was placed aside and registered as in bin 2, possible shipping ore, until such time as it could be shipped by itself or blended with higher grades.

The sample, which should represent ten to twenty tons of ore, depending on the rate of production and shipping requirements, was wheeled to a 10x12-foot boiler-iron sampling plate, where it was crushed by hand with small hammers to one-inch size. I will not go into the smaller details of sampling, except to say that the lot was cut down by successive crushings and selections by sampling shovels to about thirty pounds of 1-16-inch stuff, which was reduced on riffles to two pounds, which was subdivided, one-half being retained for bulk sample, and the remainder being bucked down to 80-mesh, divided into original and duplicate and the original sent to the assayer.

To facilitate the handling of the ore, a rather complete set of records was kept. A loose-leaf system was used. The main sheet was the "Daily Production and Time Sheet," on which the sheet number was placed, the date of ending the week, and the employee's name. Each day there was entered

the date, character of work,—mining, teaming, cook, or whatnot,—the place where working, the pounds mined, with analysis as later determined, disposal of ore, whether to first-class or second-class, the number of holes drilled with footage and explosives used, supplies consumed, time, rate of wages and amount. The ore was not weighed daily, but when sampled the entire amount was entered under the date on which the last of that lot was mined from a particular place, the combination of the sheet number, the date under which entered and the employee's number serving for the lot number as 4-13 Th. signifying that the lot so numbered could be defined by referring to sheet 13 of employee 4, and finding the entry under Thursday. Each week the employee certified to the amount of wages due, and at the end of the month to the total due, and finally signed the proper sheet on the tenth when he received his pay-check. This system avoided many of the petty annoyances over disputes as to time as well as providing a complete record of mining operations.

When the ore was ready for shipping, its lot number, number of sacks, weight of lot, and analysis was entered on the "In" side of a "Stock Sheet," and shipments correspondingly checked out. It was thus possible to tell with a moment's calculation the total amount and analysis of ore on hand at any one time. This sheet was balanced monthly. From the daily sheets and vouchers, monthly operating costs were entered on another sheet, costs being segregated under the heads of mining, further subdivided into labor, supplies and explosives; transportation, subdivided into packing, hauling ore to railroad, hauling supplies, and freight; chemical department; commissary; superintendence; mine office, the total of which was called mine operating costs. This sheet also had spaces for entering the number of days averaged per miner, tons mined per day per miner, and per men employed, and the total tons shipped per miner and per man employed.

The shipping sheet showed all the information about each carload shipped, attached to the bill of lading to be forwarded to the Philadelphia office; information given included the consignee, destination, route, car number and initial, capacity, net weight, date placed on siding, time when loading started,

and time when finished, time of departure of car, and analysis of the lot.

As the car was being filled, there was entered on this sheet all the details concerning the lots included, date hauled, weight, analysis, charges, etc.

The remainder of the records were carried in cash book and ledger, and in monthly cash statements sent to the head office. For the guidance of the superintendent, another sheet made up from the daily sheets gave all the information desirable about the tonnage mined from each working place, each place having a sheet of its own, with supplies, labor, name of miner, footage drilled, etc., brought forward.

The productivity of each working place, the efficiency of different men, the difficulty of extraction at different points, were all thus at hand for study and improvement.

The ore was hauled to Green River and stored to await a car, and was then emptied into tight box cars, which were sealed, and was shipped loose to sampling works near New York. This practice differed from the ordinary one of shipping the ore in sewed sacks, or even double sacked, and inasmuch as sacks cost $235 a thousand at Green River, a considerable saving was made both in initial investment in sacks and wear and tear on sacks.

I have gone into the handling and sampling of the ores in some detail to properly emphasize the care that was taken to insure that no mistakes would be made, and to show the foresight used in opening these deposits. It will be evident that with the great care used, success should have been assured. This was a kind of mining in which we were all but pioneers, and we were yet to meet temporary disaster from a quarter from which we had least expected it.

Assayers Unable to Get Correct Results.

The samples, obtained at so much expense in time and labor, were sent to an assayer in whom we had every confidence and who guaranteed the accuracy of his work. We depended wholly upon him, and as a result six carloads or about 200 tons of ore were en route before the returns of the first carload were received from Ledoux and Company, of New York. Assays and calculations had indicated that this first

car would contain ore averaging a little over 4 per cent U_3O_8 and very nearly the same percentage of V_2O_5. Imagine our surprise, consternation and unbelief, when we were informed that the car ran only a little over 1 per cent uranium oxide, while the vanadium oxide agreed with preliminary results. Trouble was precipitated at once. Umpire chemists were immediately secured after our duplicate samples had been forwarded and found to give the same result. These chemists were of the highest ability, some of them employed as commercial chemists, others in research departments of large operating companies, others in research laboratories at colleges in the east. All of them checked our preliminary assays, so that we confidently questioned the assays of Ledoux & Company, and had re-samplings made with the same results. We were unable to find a chemist who could check Ledoux, and Ledoux stood firm. It was only after three months individual work by the head of one of the chemical laboratories that a check was obtained and the difficulties of the analysis for uranium really ascertained. We had then to admit the accuracy of Ledoux's results. And even to-day caution is necessary in accepting the assays of a large number who feel that they are giving accurate returns, but who do not appreciate the true difficulties.

It was now evident that something radical must be done, for this grade of ore could not be sold at a profit. Shipments were stopped in April to await the outcome of the dispute as to analyses. Mining was kept up, however, with a force of twenty men, and the outcrops developed from one end of the claims to the other. About 367 tons of the best ore had been mined by the first of July, when it was decided to close down, dismiss the force except for two or three men retained on development, and await a solution of the problem of the disposal of the ore.

As soon as the correctness of the Ledoux analyses was proven it became evident that the only way to put the operations on a profitable basis was to erect a plant to treat the ores and extract the radium, vanadium and uranium, for although the ore could not be shipped, and sold at a profit, it probably could be treated at a profit.

The only alternative was to spend great sums in the attempt to secure higher grade ore.

Plenty of ore was on hand for experimental purposes, the work done had demonstrated that there were some large pockets of ore. On one claim to the north, the Pittston, ore to the amount of about 150 tons had been taken from a cut about 300 feet long, with ore all the way. On the Melrose to the south on the opposite side of a ridge a large opening had been made and about seventy tons of ore taken out, and the showing was still excellent. There were occasional outcropping pockets along the center of this claim to the discovery near the south end, where another large pocket had yielded about sixty tons, with a face in places six to eight feet high and with a length of forty feet. Beyond the Melrose in a gulch there were several pockets on both sides and a tunnel on the south side of the gulch followed ore in unprofitable quantities for fifty feet. This tunnel was on a line with a large pocket of rich ore in the next gulch, and so on to the south. The portions of the sandstone bed between these pockets had never been thoroughly explored owing to the exigencies of shipping, nor had any great depth been attained. However, the physical side of the property was such that it promised to have considerable prospective value, could a method to treat the ores be found.

At this time no radium was being extracted in the United States; the market for ores was in an unsatisfactory condition; the ore sometimes passed through the hands of four or five buyers before reaching the manufacturer in Europe; good terms could not be made, every advantage being taken of the innocent ore-producer to get him to sell at the lowest possible price. There can be no objection to allowing the manufacturer a good profit on the work. Its nature justifies it, the risk is great. Although radium was known to be in these ores not much had been thought up to this time of keeping this metal for ourselves instead of selling it so cheaply abroad. The conclusion finally reached was that it was better to do away with all the middle profits, and take the refiners', the buyers' and agents' profits for the mine, and to make the radium at home.

For awhile Camp Vanura was practically deserted, little

work being done in 1913. Chemists in the employ of the syndicate were attacking the problem of producing radium. A process was devised in course of time, which depends on none of the known processes details of which are now so freely offered because they are not wholly satisfactory. A company was incorporated known as the Radium Company of America, and a plant established at Sellersville, Bucks County, Pennsylvania. This plant began to produce radium in November, 1913, being preceded a few months by the Standard Chemical Company, with a plant near Pittsburg.

How Radium is Sold.

The radium salt here produced is sent to the company's physicist with the order of the buyer, and the amount desired is separated and placed in a small glass tube about 1-16 of an inch in diameter and about one inch long, sealed at both ends and placed in a larger tube, on cotton, and this second container is sealed with the company's seal. Accompanying the radium preparation is a certificate of quality signed by several responsible officials, operating heads, and physicists of the company.

Formerly the method of preparing the radium preparation for sale was much more elaborate. One of the daily consular trade reports of the government states that radium is sold by the Austrian government in the form of radium-barium-chloride in quantites certified and guaranteed by the government institute of the Vienna University.

"Each radium preparation is inclosed in a round so-called radium cell, 21-mm by 9-mm, of nickeled brass. The bottom is run full of lead, and a small square hole is punched in the lead, in which the radium is placed. The cell is then closed with a mica plate, and the radium ray can be utilized without opening the cell, which is officially stamped and consecutively numbered and a careful record kept so that the powerful material may not get into undesirable hands."

Contrary to a general belief the use of this form of container has nothing to do with the danger of handling the material, but was designed for use in the application of the radium. The manufacturer does not now concern himself

with the form of container. The user of the radium may put it in aluminum, or in silver, or gold if he so desires. The manufacturer puts it in glass.

A certain amount of radium contained in a relatively large bulk of the salt is just as effective as the same quantity would be in the metallic state, and in addition some bulk is given the radium preparation so that it is easily handled, divided or applied, and the useless cost of producing the pure metal is avoided. In fact there is not more than a speck of the pure metal in existence.

The Price of Radium.

The price at which radium sells at present ranges from $120 to $180 milligram of metallic radium. I am aware that this is somewhat higher than prices quoted in the press, but it is the present range.

Prices are dependent on several factors, chief of which is the quality of the product. Closely connected with this factor is that of the responsibility of the seller. The guarantee of a highly responsible producer is an item of value when purchasing radium. The electroscope may show the proper radioactivity for the specified amount of metallic radium, which may be due to other substances, such as thorium, and these adulterants do not of course have the same value as radium. And this adulterated product may be due to ignorance rather than dishonesty.

Another factor which may be mentioned in the degree of certainty of prompt delivery at the time wanted. There have been delays and failures to deliver and the manufacturer who fills his contracts promptly will command a higher price in this business as in any other.

What is Radium?

Much has been learned about radium and radio-activity in the short time since the discovery of this metal and this property, and for details which should be enough to satisfy the casual inquirer, I would advise that you consult the recent editions of standard encyclopedias, and spend two or three hours studying their marvels. There are of course a few good books on the subject but these are mainly filled with technical details and abstruse formulae and logic, which would discourage the ordinary seeker after knowledge. On the oth-

er hand there have been some attempts to present the matter in a popular and easily understood style. One of these so-called books on radium came to my attention a few days ago in which the writer states that no book dealing with the subject as a whole has appeared, and that he will attempt to cover the subject. Before I had finished his account, I had coined another word which I feel applies to this book as well as to certain other uses of radium and its properties. The word was "radio-graft," And so I will not repeat this writer's mistake in trying to tell you in so many words what radium is.

I will merely mention a few facts which seem to be generally accepted as true.

It is pretty definitely proven and accepted that radium is a product resulting from decomposition of uranium. Uranium has a life estimated at 5,000,000,000 years. It transforms into uranium X, which has a life of twenty-two days, and in turn changes to ionium, a radio-active substance isolated by Boltwood in 1905.

Radium is a child of ionium and probably retains its activity for a period of about 1,750 years. It gives off three rays, designated as alpha, beta and gamma rays. The alpha rays are positively charged helium atoms, which are stopped by a single sheet of paper. They have great energy, and a peculiar power of causing fluorescence in various compounds and minerals. Crystaline zinc sulphide, or blende, glows with a beautiful vivid green when subjected to these rays. The beta rays are regarded as single electrons charged negatively and are identified with the well known cathode rays. They will penetrate sheets of glass and aluminum several millimeters thick, but are stopped by less than a centimeter of lead.

The gamma rays are non-electrified but have a high penetrating power and of course a great effect on photographic plates. They also produce the fluorescent effects and will pass through a great thickness of iron.

In addition, radium gives off a gaseous emanation, which can be absorbed in water. Its life is short, about five and one-half days, and it goes through various transformations, designated as radium A, radium B, etc., to radium G, which is regarded by some as the same as radio-lead. The life of

many of these forms is measured in minutes, and they also give off some of the rays.

Similar changes occur in the other radio-active substances.

Factors in Future Development.

Among the active factors in the future development of radium and its application, besides the medical profession, may be mentioned the United States Bureau of Mines, and its affiliated National Radium Institute, with which you are all familiar through the publicity given to their affairs. Less known to the public in general, but a factor which will undoubtedly have the greatest influence in directing the application of radium is the Radium Institute of America, composed of leading scientists of this country.

The use of radium in therapeutics has already made great advance. In certain cases, such as rheumatism or gout, it has done marked good. As a means for curing cancer, there is some difference of opinion although it has had remarkable effects on superficial cancer. Perhaps the best work at present is being done at Harvard University in the study of its effect on cancer where a large fund is available for this research.

I have outlined the sources from which we may expect the greatest advance in radium therapy. There is much speculation as to the future of radium. It is extremely likely that the use of radium will increase fully as rapidly as the supply. Many of the projected radium plants are doomed to failure. Money alone will not successfully operate a radium plant. The process is complicated; the skill required, great. If the least part of the process goes wrong, much time, trouble, and value is lost in the necessary readjustments. There will be other plants, it is true, and there will be increased ore supply for a time. Radium itself, may be regarded as imperishable, yet there is use for all the radium that can be produced for some time to come, and radium salts of the highest activity will probably continue to bring the highest of prices.

Carnotite as a Fertilizer.

Besides the use of radium in therapeutics and in pure science, the use of the carnotite ore, mixed with other ingredients, has been suggested for fertilizing purposes, and some large claims have been made in this line. In order to have

something authoritative on a matter upon which most of us are unqualified to express opinions, I wrote Mr. Frank Cameron, in charge of the Bureau of Soils for the United States government, concerning the use of carnotite as fertilizer. In reply he stated that he could perhaps best answer my inquiry by sending a memorandum which he had just had prepared by Dr. W. H. Ross of the Bureau of Soils. This is a lengthy memorandum of much interest, from which I will quote the following as applying directly to the subject under consideration:

"Most soils differ very little in their radium content, as must follow from the fact that almost all rocks contain pretty much the same quantity of radium. On an average the radium present in an acre-foot of soil amounts to about three milligrams. The radium present in one ton of carnotite ore containing two per cent of uranium oxide (U_3O_8) amounts to five milligrams. To duplicate the amount of radium in an acre-foot of soil would therefore require three-fifths of a ton of two per cent carnotite ore from which the radium has not been extracted, and which is worth $80 a ton wholesale. It is thus quite evident that to increase the radium content of the soil to any great extent by the use of carnotite or any other radium ore is out of the question as an economical proposition, and as a matter of fact the radium in an acre-foot of soil is many times greater than that present in the quantity of "radioactive manure" recommended for application to an acre, in the materials now being offered for sale."

"Like any other chemical or physical agent, radium emanation affects the growth of plants when used above a certain concentration. The radium emanation in one cubic centimeter of the air contained in the soil is equal to the amount in equilibrium with 2.4×10^{-13} gram of radium. No noticeable results have ever been obtained with this concentration of radium emanation, and to increase the concentration of radium emanation in the underground air of the soil by the addition of radium to the soil—the only way in which it would be feasible to increase the concentration of radium emanation in the neighborhood of a plant in an open field—is as already explained so altogether expensive as to be obviously absurd.

"When consideration is, therefore, taken of the fact, (1) that the greatest quantity of radium which can exist in an ore amounts to only 0.00003 per cent; (2) that the intensity of the radium rays is limited by the quantity of the radium on hand; (3) that all rays like all chemical substances must exceed in intensity, or concentration, a certain limiting value to produce any noticeable results, or any results whatever; (4) that the physiological action of radium, generally speaking, is not more powerful than that of some other substances which can be obtained in much larger quantities; (5) that radium costs $120,000 a gram; (6) that the activity of radium or any other radio-element can not be increased by any treatment whatsoever, but remains unchanged in whatever state of combination it may exist, it surely is unreasonable to suppose that radium or any of its products can have any economical application as a fertilizer; and still less reasonable to suppose that the so-called 'radio-active manure' has any value whatever, as far as its radio-activity is concerned, since the radium already present in an acre-foot of soil is at least several times greater than is contained in the quantity of radio-active manure recommended for application to an acre.

"It would obviously be a waste of time to make field tests to demonstrate the fertilizing value of the so-called radio-active manure, for in order to prove that mixing manure with the carnotite residues from which radium is largely extracted thereby increases the activity of the whole, as claimed by those interested in the sale of this material, it will be first necessary to disprove the published results of Sir J. J. Thomson, Sir E. Rutherford, Sir Wm. Ramsay, Madame Curie, and scores of other distinguished scientists."

I would recommend that you investigate any radium preparation, crude or artificial, which may be brought to your attention in the light of the above facts. They will answer many questions as to the uses of carnotite ore.

Utah Has Large Carnotite Reserves.

Utah has an undoubted large resource in carnotite ores. Lack of transportation is its chief drawback, but Green River has the shortest wagon haul of any producing locality to-day,

and developments of the past three months have shown that much ore is to be found where there is no surface indication of it; that by going into the sandstone under the conglomerate for six or eight feet ore has been found, which has some evidence of being in larger pockets and is of a higher grade. Recent work of this kind in one of the gulches near the south end of the Melrose claim of the Radium Company has opened up a six-foot face of ore, fully a carload of ore being in sight in this opening. This new ore is nearer what the original assays indicated the outcrop ore to be, and there now seems every likelihood that Camp Vanura will produce a good grade of ore for some time to come. Eighteen men are at work and more ore is being rapidly extracted for treatment at Sellersville.

Other localities are steadily being found in the state, and while development will be slow without transportation facilities, no concentration methods have yet been devised which are at all satisfactory and the question of even the desirability of concentration is still a moot one. From the nature of some of the ores the losses will always be great in concentrating.

The greatest credit for the successful issue of operations at Green River is due to Angus Cameron, president of the Radium Company of America, through whose perseverance disheartening difficulties were overcome; disappointments only spurred him on; he has never sought, but always avoided publicity; and the greatest tribute to the conservative basis of his operations is the fact that heretofore so little has been known of what was being done; and even to-day few are aware that the Radium Company of America has the largest plant in the world for the production of radium.

The sample of pitchblende from Joachimsthal was loaned by E. R. Zalinski, a local mining engineer, who secured it when on a trip of inspection to these mines in 1902. The sample of patronite was furnished by Mr. Alfred Hale, mining engineer of Denver, and the sample of roescoelite was sent me by the Primos Chemical Company, of Vanadium, Colorado, and Primos, Pennsylvania.

I am also indebted to Angus Cameron, president of the

Radium Company of America, for his kind acquiescence in this use of the information acquired while in his employ.

NOTE—The illustrations accompanying this article show various phases of carnotite mining at the mines of the Radium Company of America, Camp Vanura, San Rafael Reefs, Green River, Utah.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

THE QUANTITY SYSTEM OF ESTIMATING—THE BEST BASIS FOR BUILDING CONTRACTS.

By G. Alexander Wright,* President of the Technical Society of the Pacific Coast.

The measurement and description of mechanics' work and the placing of money values against such description is not new. Occasionally, when discussing the quantity system, one hears it spoken of as a "new idea." But it is not new by any means. The practice, however, of making a fixed "quantity" of material and labor the "essence" of the contract, if not new, is certainly "modern."

Historically speaking, there were measures of quantity, areas and distances, in very early times. Ezekiel, the prophet, speaks of a man with a line and a measuring rod in his hand. Someone has said it was just a twelve-foot rod, such for example, as we might use to-day. Then in Zechariah, reference is made to the length and breadth being taken of Jerusalem.

That the Greek architects took their measurements and made up their estimates of costs is generally admitted. Vitruvius, in his Handbook of Architecture, written about the time of Augustus, mentions as one of the essential qualifications of an architect, that he must be a good arithmetician "to work out measurements and to estimate the cost of buildings." Indeed, in the case of public work in the city of Ephesus the architect was obliged to give a figure representing the cost of the work, which was retained by the chief magistrate, and honors were conferred upon the architect if, at the end of the job, this estimate of cost had not been exceeded. If, however, the cost materially exceeded the estimate, the architect had to make up the deficiency, and it is said it was a matter of regret to Vitruvius that there was no such provision in the Roman law. Then, again, among the Greeks, it was customary upon public work to publish item-

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ized detailed accounts of the actual cost of such works, as well as the achitect's estimate. Payment by measurement was very common, and we find references to a type of engineer-architects who measured buildings and whose reports finally settled matters—a sort of arbitrator. Here it will be seen, therefore, that we have distinct references to the principle of "payment by measurement," the modern equivalent for which is the quantity system, whilst the Greek engineer-architect accords very closely, to the quantity surveyor of to-day.

Enough has been said to show that the measuring (or we say "quantity") surveyor has existed, certainly from the time of the Greeks and Romans. The quantity system as we know it to-day had its origin some eighty years ago when competing bidders met and one of their number was selected to take off the quantities and furnish a copy to each of his competitors.

Better methods in time prevailed until the system was evolved such as I expect to see adopted in the United States, i. e., compensation to the contractor through definite measurement being made the basis of the contract.

Competition, so called, among contractors is comparatively a modern innovation. The words "so called" are used intentionally, for under the prevailing conditions, competition intelligently and conservatively conducted is the exception, and not the rule. Our methods to-day are largely gambling methods when it comes to ascertaining the quantities of materials which go to make up a structure and which must, of course, be accurately ascertained before an intelligent, satisfactory bid can be made. So true is this that it is a matter of common knowledge, that fully fifty per cent of the contracts let are the result of error, and further, that the more capable and careful a bidder is, to get in all his items, the less chance he has of securing a contract, profitable or even otherwise. The lowest bid, the one generally accepted, is usually anything but the most accurate.

One of the greatest inconsistencies also, in competitive estimating, lies in the fact that no sooner are bidders invited to give a price on a job, than they seem to compete among

themselves to see who can take off the least quantity of material, etc., and it is surprising how well some of them succeed.

The quantity system is not, as some persons have supposed, merely the taking off of a list of items by one person, for one other person's use, nor does it consist solely of the listing of items by individual contractors with varying methods and uncertain accuracy, owing in part to the fact that contractors are seldom, if ever, allowed proper time in which to make up an accurate bid. It must not be overlooked that some "training" is also essential to the accurate preparation and classification of quantities.

What the Quantity System does mean, however, is the careful measurement by an independent person specially trained in this special kind of work, and the present age is undoubtedly the age of the specialist. This specialist or quantity surveyor, proceeds with his work somewhat differently to the average contractor, for he follows certain recognized rules in taking off, abstracting and billing, with a view to eliminating error. He uses also certain uniform standards of measurements, and expression. Every written word or figure is preserved for future reference. His checking and rechecking methods to ensue accuracy, must be studied, to be appreciated by those to whom the Quantity System is unknown. A record is made of every item, however small, having a money value. These items are then all classified and arranged, each under its proper trade or department in methodical order. Guess-work methods are unknown to the Quantity Surveyor, whilst his accuracy and attention to details is well worthy of comment.

The surveyor who does this work is a professional man similar to the engineer and the architect. He should, in fact, have, and usually has had some experience at least in the work of these professions, and in addition, a practical experience acquired in the field, in actual superintendence of construction work.

Such a surveyor then upon commencing to take off quantity from an architect's or engineer's drawings, readily detects any ambiguities, or discrepancies which exist, through hasty

preparation or otherwise. Attention of the architect or engineer is at once called to such matters by the quantity surveyor, as he goes along. Being so detected, such ambiguities and uncertainties can be, and are, corrected and adjusted, so that by the time the drawings and specifications reach the bidders for estimating purposes, all doubts have been cleared up, and everything has been made so plain and accurate, that the possibility of error in quantities can be practically disregarded.

This document, prepared exclusively in the surveyor's office, is then either printed or similarly reproduced, and a fac simile copy supplied free of cost to each bidder, who inserts his unit price opposite each item, and readily foots up the money cost in dollars and cents, and which really is all that he should be asked to do. The quantities of materials and labor then set forth in this document, or bill of quantities, represents the limit of what the contractor will be called upon to perform or furnish, in order to complete his contract. In short, the bid becomes a proposal to do a certain "fixed quantity" of work, indicated in the quantities, no more and no less. The contract to be drawn accordingly. This then very briefly is the main underlying principle of the Quantity System of Estimating, a definite quantity of work for a definite price, and payment according to a well defined systematized method of measurement, and the entire elimination of those well-known conditions and elements, which now compel bidders to take chances, and for which all parties usually suffer in the end, the owner included.

Most of us are familiar with these wasteful, unsatisfactory methods, and sometimes, even pernicious practices, which are followed to-day in bidding upon and carrying out work. These injure both parties to a contract, and they arise largely from bidders' mistakes in figuring, because accuracy has to be so often sacrificed for an ill-advised speed. A large proportion of these mistakes occur in the hurried figuring of the "quantities" by bidders. Some of us, when we have the opportunity of looking behind the scenes, so to speak, become appalled at the resultant effects of existing practices, such as the enormous waste in time and money in useless figuring, disputes, harassing conditions, hard feeling, lack of confidence, delays,

suits at law and so forth, nearly all of which may be avoided by adopting more conservative modern methods in our preparatory work, before contracts are let. Further, interpretation of plans and specifications should, in common fairness to both parties to the contract, be made wherever possible, before a contract is let, and not be left until afterwards, nor to be done "as directed." Under the Quantity System, where the quantities are made the basis of the contract, this becomes practically imperative. Regarding interpretations, one might be excused for saying that it would seem, as engineers or architects, to be a question of policy, as well as fairness, whether we should continue to even assume the responsibility of deciding things already contracted for, according to our "judgment." If our judgment is to govern what a contractor must do, would it not be better to consider those things which can be considered, and then determine them finally *before* a contract is let. Many an architect and engineer has suffered professionally through assuming to exercise judiciary powers unnecessarily. But, to return, notwithstanding the fact that over 40% of the entire population of our cities are dependent directly or indirectly upon the construction of buildings, yet the methods generally followed to determine the important question of contract cost, are those used generations ago; they come to us as a tradition from the period when tallow candles were used. Whilst we have made wonderful strides in constructive methods and materials, and, let us hope, in design, little or no attention has been given to standardizing estimating methods. We seem to have been too busy "speeding up," to regard seriously the advantages of accuracy, when it comes to spending money on construction. In the end, of course, it is the owner, the financier, who suffers. There are, however, indications as a result of the movement initiated in San Francisco, that more conservatism and a closer adherence to business principles are going to be preferred by the moneyed interests in place of the guess work and gambling methods which they have overlooked in the past.

A contract according to Blackstone, is "an agreement upon sufficient consideration to do, or not to do, a particular thing." The lowest bidder to-day will scarcely admit that the contract

consideration is sufficient, or that his contract obligations are limited to do any one particular thing. It would also seem that architects or engineers who permit an unduly low bidder to sign up for a piece of work are courting trouble, and in such cases, where they have constituted themselves sole arbiters of the contract, their judicial powers, if exercised, is open to criticism.

The principle of measure and value, or payment by measurement, usually designated as the Quantity System, is based upon equity and square dealing. On large work it is used in Germany, France, Ireland, England, Australia, Scotland, and even in South Africa, where some thousand miles or more north of Cape Town we find not only an Institute of Architects, but an Institute of Quantity Surveyors, and it is a significant fact, that in no instance where the system has been once established, has it ever been abandoned for their former haphazard methods, and which corresponds with those we have employed for generations past and still use.

Among the advantages and improved methods of estimating afforded by the Quantity System may be mentioned: First, the enormous saving of time and money now wasted by numerous bidders all doing the same thing, going over the same ground. Second: Safer bids will be made, as the volume of work to be performed is clearly indicated by the Bill of Quantities which is the essence of the contract. Third: No expense to the bidder, the owner pays for his own quantities "knowingly," and they benefit him as well as the contractor. The owner pays now, but this fact is not emphasized or brought to his attention, and so he does not know it. The percentage added to a bidder's net cost is not all profit, a certain portion of such percentage is absorbed in costs of running his business and similar overhead charges, which ultimately are, of course, paid by the owner. Fourth: Saving of disputes arising from extra claims which often occur through vagueness of drawings, and omissions, or other error in specifications. Fifth: Better opportunities for the careful competent bidder. With the Quantity System the bidders all work up from the same basis. The incompetents cannot omit or forget the painting, glass or other items, and so take work away from more careful or competent bidders.

Sixth: Better work and more harmony will result, for the reason that if no part of the work has been omitted there will be less temptation to "let up" on the work, and which usually results in dissatisfaction, if not friction or worse. Seventh: Misunderstandings reduced to a minimum. The Bill of Quantities is the "interpreter" of what is intended, a sort of clearing house for the drawings and specifications. Eighth: Neither party to the contract can obtain any advantage over the other on quantity or description of work. Ninth: No disputes with sub-bidders, it being clearly stated what each trade is to furnish. Tenth: Contractors having much less figuring to do can then devote more time and give more attention to buildings in hand, and especially in supervising and directing their sub-contractors, which is much wanted now. Eleventh: Owners and architects would be less liable to have inferior contractors as the lowest bidders. Twelfth: Fewer extras. These are usually a trouble to all concerned. Should any occur, they can be easier adjusted if the schedule prices govern in such case. Thirteenth: The architect or engineer, if he so desires, can have the advantage of collaboration with the professional Quantity Surveyor, who also would be available when preliminary figures are required, which information is now so often furnished by the contractors, thereby creating an undesirable obligation. Fourteenth: No change or re-organizing of architects' or engineers' offices necessary, whilst much detail work, now involved when taking figures, will be taken care of by the Quantity Surveyor's office. Fifteenth: When contracts are signed, the drawings and specifications will previously have been made as complete as it would be possible to make them, thereby avoiding subsequent inconvenience to the contractor and his foreman on the job, and doing away largely with inquiries at the architect's offices by contractors during progress of the work.

The particular system suggested for our use should be one best adapted to American needs and sentiment, a practical system, which would meet our special requirements and endorsement. Such a system has been under consideration for some years past, one that is expected to meet with general approval and adoption, at least until experience, or wiser heads suggest something better. For many reasons it would be un-

desirable to accept the English system in either of its forms. That is to say as a "system" for general use. The great principle it stands for, however, viz.: that of giving, as well as receiving a square deal, can be both accepted and used with much advantage to both owner and contractor. It suggests no haphazard or guess-work methods, which is true business and fair to all.

Now, very briefly: How can this system be adopted? It takes time of course to get rid of old customs or old habits, however bad they may be. But considerable progress has already been made, and the outlook all over the country favoring better methods is now certainly encouraging. At the inception of this movement, however, in 1891, it was not easy to find anyone willing, even to admit, that betterment in estimating conditions were necessary, or even possible, and there were fewer people still, who knew anything about the Quantity System. Happily we are a progressive people, and things are not done to-day as they were twenty or thirty years ago. Indeed, it is now very generally recognized that estimating and certain contract conditions are about as bad as they can be. Quite recently it was stated by an experienced contractor whose opinions both deserve and command respect, that if a bidder figured to do everything just exactly as it was called for, he would not get one job in fifty, and the reasons why, are well known to those in the business.

After once the principle, and the safety of the Quantity System is understood, (and the words "Safety first" should become a national slogan), after its many advantages are recognized, its equity between owner and contractor, becomes immediately manifest.

To adopt the system generally, the organization referred to hereafter, advocates that the United States Government and every state and county in the Union, should furnish, free of cost, to every bidder detailed Bills of Quantities. setting forth clearly and squarely exactly what quantity and nature of work it is that a bidder will, if successful, be required to perform in order to properly complete the contract. The next step, it is thought, will be that municipalities will follow the same practice. The advantages obtained will quickly become known in every locality among private own-

ers and the building community, and the present practice, which is already tottering, will be a thing of the past, and we shall all be wondering why such a labor saving, sensible method has hitherto been neglected in the present day, and in our generation.

Accuracy and honesty are the Quantity Surveyor's chief essentials, apart from his professional ability. It seems, therefore, that the practice of Quantity Surveying should be legalized in each state, somewhat similar to that of the public accountant, through examination and subsequent issue of licenses to persons thus qualified and wishing to practice. The furnishing of surety company's bonds by the Quantity Surveyor, has been suggested in some quarters, to guarantee his accuracy and honesty, but it would seem that until a similar guarantee is demanded from other technical practitioners, the expediency and efficiency of this course may fairly be questioned.

It may be stated perhaps, that to still further advocate the adoption of better estimating methods and more satisfactory contract conditions, an organization was formed last year known as the American Institute of Quantity Surveyors, which is doing much good work along these lines. Its membership is open to all architects, engineers, contractors and others (including owners) who are in sympathy with the efforts being made to bring about better conditions. The dues are merely nominal including the official Bulletin every month which gives the progress of this movement throughout the United States, whilst its columns are open to all, for suggestions, or inquiries regarding the work of the organization in general, or the Quantity System in particular.

It may perhaps be only fair to add (with due modesty, however, let us hope) that, to San Francisco belongs the credit of being the first city in the United States in which a systematic effort was ever made to bring about better estimating conditions such as the Quantity System affords. This movement commenced many years ago, in 1891, when in the month of April, an informal address and discussion took place before members of the Builders' Association of California (now the General Contractors' Association).

Immediately following this came an address entitled "The

Quantity System of Estimating" in the Academy of Sciences Building before the San Francisco Chapter of the American Institute of Architects. Much interest having been aroused, no opportunity was afterwards lost of sustaining it. Articles were contributed to Architectural and Building Journals in the East and elsewhere. "Better Estimating Methods" was the slogan consistently urged for years. In 1905 a paper on this subject was given and discussed before the Technical Society of the Pacific Coast. The conflagration in 1906 somewhat disturbed the progress of the work temporarily, but it was soon resumed and brought once again to the front. It has since grown until now the movement has spread from the Pacific to the Atlantic, and from Boston to New Orleans. Everywhere to-day the subject is being received by engineers and contractors, as well as by architects with the greatest interest, I can testify as to this, having but recently completed a tour of some 14,500 miles undertaken solely for the purpose of meeting the leading architects, contractors and engineers of our large cities, and of personally still further advocating higher contract ideals and better methods, such as always follows the adoption of the Quantity System of Estimating.

EDITORIAL NOTE.

The Quantity System of Estimating has been systematically advocated since 1891. From time to time it has attracted much attention among Contractors, Architects and Engineers as a direct result of Mr. Wright's long continued and well known activity with the subject. In course of time this system of estimating must be adopted, as it always stands for a square deal between owner and contractor, which is much to be desired. The movement in aid of this work is purely a voluntary one, an honest effort to bring about a betterment of existing estimating and contract conditions, and which when consummated will be a boon to all concerned, including the owner.

Those of our readers who are in sympathy with this work, or who desire information concerning the system, or who may be willing to participate in the good work are cordially invited to communicate with Mr. Wright personally at 571 California Street, San Francisco, California.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

THE EFFECT OF SATURATION ON THE STRENGTH OF CONCRETE.

By J. L. Van Ornum,* Member of the Engineers' Club of St. Louis.

[Read before the Society, October 1, 1913.]

The paucity of recorded information concerning the treatment of concrete specimens, with regard to moisture conditions during their storage while awaiting the test for strength, seems to indicate a general supposition that this feature has no considerable effect on results. Apparently corroborating this attitude is the statement in the recent report of he Special Committee on Concrete and Reinforced Concrete, in which, while specifying the exact dimensions, mixing, consistency, age, etc., of test specimens, the only requirement designed to control moisture treatment during their curing seems to be that they shall be "stored under laboratory conditions." It is the purpose of this paper to invite attention, not only to the great importance of specifying and standardizing the moisture treatment of specimens intended for testing, but also to the further fact that similar condiions, as they act on the finished structures, will affect their strength considerably, and therefore should be considered in specifying the proper unit stresses. It is evident that this factor should not be ignored when great variations in strength, to an amount of perhaps 50 per cent above or below a mean value, result from differences in moisture conditions.

During the last six years this question, at times, has been the subject of investigation in the Washington University Testing Laboratory. Different features have been explored experimentally, as work on graduation theses, since 1907 by Messrs, Trelease, Feinberg, Harris, Start, Bank, Caplan, Bryan and Keller. Although these tests leave the greater part of the field still untouched, the writer believes the results thus far obtained to be so definite in their showing of a decided influence of moisture conditions on strength, and so significant in their general indications, that he offers this summarized statement of experimental results to the Engineering Profession for its consideration.

The most important part of the investigation is that of the effect, on the compressive strength of concrete, produced by vary-

*Professor of Civil Engineering, Washington University, St. Louis, Mo.

ing systematically the relative length of time of exposure in air and in water.

The test specimens were cylindrical, 8 in. in diameter and 16 in. high. The materials were: a standard brand of Portland cement which fulfilled thoroughly all the requirements of the standard specifications; a clean sand of good quality, weighing about 110 pounds per cu. ft. when dry, and having 36 per cent voids;

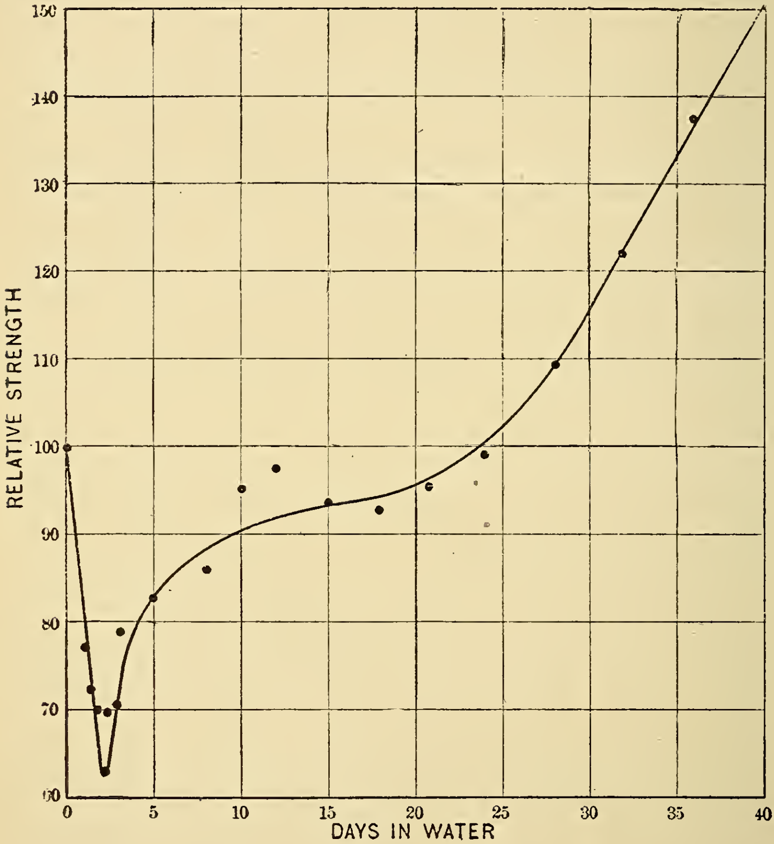


FIG. 1.

and a washed river gravel of the same weight, varying in diameter from quite small up to 1½ in., and having 33 per cent voids. The proportions were the usual 1 : 2 : 4, by volume; the mixing was done thoroughly by hand; and the quantity of water used was such as to give a moderately wet consistency, which allowed

a thorough compacting by stirring with an iron rod and a slight tamping. All details of fabrication, curing, and testing were planned so as to secure such complete uniformity as is practicable to obtain in all regards except the one for which the controlled variation formed the particular purpose of the experimental study.

The cylinders were removed from the moulds when 2 days old, and were tested at an age of 6 weeks. The intervening 40 days constituted the period in which the duration of their immersion in water was varied systematically from nothing to the full time. The average results of the 240 tests thus made are plotted on the diagram, Fig. 1, on which the abscissas represent that number of days (after the 2 days in the moulds and the time of exposure to air) during which each set of specimens was placed in water before crushing them; and the ordinates give the percentage of strength which each set of immersed cylinders (standing in water for the indicated number of days) was found to have, taking the compressive strength of the dry specimens from the same mix as 100 per cent. Thus, at the extreme left is represented the basis of comparison, or those which were not immersed at all; those specimens which were cured in air of ordinary humidity for 32 days and then immersed for 8 days are shown by the black circle to be 86 per cent as strong as the air-cured concrete; those in air for 12 days and therefore finally cured in water for 28 days, have gained 9 per cent in strength; and those submerged for the entire 40 days exhibited an average compressive strength fully 50 per cent greater than that of the air-cured specimens.*

An average curve for the plotted points has been drawn as a full line, showing the systematic increase in strength as the time of submergence is lengthened beyond 2 days; but there exists the significant fact that specimens, of the dimensions used, decrease rapidly in strength when stored in air for 38 (or more) days and then placed in water for the remaining 2 days (or less). This particular feature of the rapid loss of strength on first exposure to water, and the active but slower recovery of strength as soaking continued, required a multiplication of tests to determine satisfactorily the locus of the curve in this region; and conse-

*Some other experiments have also shown that concrete aged entirely in water is considerably stronger than when left continuously in air, as reported by Rafter, Withey, and the Watertown Arsenal.

quently more than half of the experiments were concentrated in this descending and the adjacent rising portion of the plot.

It thus appears that the compressive strength of concrete exposed to air may be reduced nearly 40 per cent when saturated with water, but that this loss is actively regained as the treatment is continued. The word saturation is used advisedly, because the minimum strength was found to coincide practically with the length of time required for water to penetrate to the middle of the specimens. Very plainly, this loss of strength has no relation to the percentage of contained moisture, as it is not only regained but much exceeded if the saturation is continued long enough. Perhaps the reduction in strength is purely a temporary physical phenomenon which is gradually counteracted and finally dominated by continued saturation permitting the imperfectly developed chemical processes of hardening to proceed actively. If this be true, concrete would regain something more than its original strength if dried out as soon as completely saturated, but this value would be less than that attainable by a continuance of the water treatment; also a repetition of soaking after such an experience would again temporarily reduce the strength, but less than before. These questions, as well as others, such as the duration of saturation necessary to prevent the temporary relapse of strength described, the corresponding effects of other periods of treatment similar to that discussed, of alternating the exposure to air and water, the result of different dimensions, proportions, materials, etc., all offer a large, interesting and fruitful field for investigation.

In a series of experiments on the factors affecting the strength of bond between concrete and embedded steel, 74 tests were made to determine whether there existed the same tendency of rapid weakening at first and a following recovery of strength when the dry specimens were immersed in water. The concrete was of the same character as already described, and the test specimens were partly of the notched beam type transversely loaded, and partly of cylindrical form in which the rod was pulled from the embedding concrete. All care was used to make the methods of testing such as to minimize all variables except the particular one the effect of which was sought. The results indicate clearly, for both plain and deformed bars, that the bond strength values, similarly, decline rapidly and then increase after satura-

tion is complete, as is the case with the compressive strength; although the average minimum observed was only about 75 per cent of that of the specimens cured entirely in air. Whether or not this percentage really marks the greatest weakening of bond produced by immersion at an age of 6 weeks is somewhat uncertain; perhaps additional tests for intermediate periods of soaking would have developed a further reduction in strength. At any rate, a similar behavior characterizes the bond values obtained during the first few days of saturation.

Thirty-two beams were made of such dimensions and amount of longitudinal reinforcement (without any web reinforcement whatever) that failure would always occur through the effect of the excessive web tension in the concrete. The materials were of the same quality as those already described, and equal precautions were taken to secure reliable results. These beams were also tested at an age of 6 weeks, but the small number restricted the investigation to lengths of immersion designed to detect only the early loss of web tensile strength and its subsequent increasing value, without tracing it throughout successively lengthening periods of exposure to water to the limit of 40 days. The characteristic effect is again the same, the lowest average found being again practically three-fourths of the strength of the air-cured specimens. It may be that, in this case also, the minimum value was not detected.

A series of experiments on concrete prisms when 7 years old, to determine any change due to age in elastic properties, has been discussed previously by the writer.* It may be stated, in reference thereto, that the modulus of elasticity of these old prisms exhibited a practically constant value throughout the repeated loadings equal to the maximum before found, which was about 80 per cent greater than the final constant value as then reported for prisms of ordinary age; or a value of 4,000,000 in compression for that 1: 3: 5 limestone concrete. In these experiments two specimens were immersed in water until saturated and then carefully tested; the resulting compressive modulus of elasticity for wet concrete was 60 per cent of that observed on the same specimens when dry. This lowering in value refers, again, only to the effect produced as soon as the saturation is complete; and has no reference to a continuance of the

*Transactions, Am. Soc. C. E., Vol. LVIII, pp. 312-13.

exposure to water, such as is reported on certain other tests,* where the figures given for the compressive modulus of elasticity of concrete specimens cured entirely in water for 26 days are about one-fourth greater than for those cured only in air.

As the various strength values of dry concrete are temporarily reduced from 25 to 40 per cent by saturation, it would seem that this fact should be given definite consideration in fixing the working stresses used in the design of structures which may be thus exposed, or else conditions should be controlled in such a way as to prevent the weakening thus produced. No such effect occurs in concrete constantly under water or in moist earth from the time of its fabrication; but construction above ground, and therefore exposed to dry air for a time and then to a heavy rain or other source of rapid wetting, presents conditions under which this reduction in strength exists temporarily. Fortunately, the remedy is simple and inexpensive. It is to keep the exposed material thoroughly wet until its enclosure by exterior walls and roof renders its saturation by rain impossible. The case of parts not thus protected, or those for which enclosure is delayed, is not so simple; because the length of time of saturation which will make the concrete safe against serious reduction of strength is uncertain. The systematic wetting of concrete is a well-known principle of good construction; but the writer's observation and experience suggests a very considerable tendency to regard that procedure as abstractly correct, but practically rather specious or trivial. One purpose of this paper is to present the facts in such a way that the frequent, thorough, and faithful wetting of all parts of such concrete structures shall henceforth be no more ignored than is now the protection from freezing or disturbance while setting. Probably this treatment should be continued for a length of time substantially greater than that heretofore indicated—perhaps for a period expressed in weeks instead of days.

Undoubtedly, carelessness in a thorough control of this kind is a frequent contributing cause of weakness which is sometimes sufficient to result in failure. Very evidently, this temporary weakening of concrete by saturation is amply covered by the factor of safety required by good practice, if it be the only fault; but the materials may be considerably below standard, or the

*Bulletin No. 175, University of Wisconsin, p. 17.

workmanship may be defective, or the design may encroach on the reserve of safety, or the occasional overload may be imposed; and if the material man, the construction superintendent, the designer, and the user of the structure should each rely on the others to meet fully the requirements, in the expectation that his own delinquency will be safely covered by the factor of safety, it would not require an impossible coincidence of such conditions to cause disaster; especially in view of the fact that considerable variations from the average strength values, which form the basis of design, necessarily exist in different parts of the structure. In fact, the failures which have occurred are generally a result of several such contributing causes. The writer believes that the considerable weakening produced by the saturation of dry concrete has invariably been a contributing factor in all those instances in which there was an active wetting of dry or partly dry concrete when subjected to essential stresses.

This general proposition furnishes one more evidence of the remarkable responsiveness of concrete to variations in its treatment. The fact that differences in control (which to the average artisan are seemingly unimportant) actually do exert a positive influence on its essential characteristics, constitutes a definite warning against entrusting it to the uncertainties of irresponsible or skeptical supervision, and assures ample reward for a competent control which is correctly adapted to develop its capabilities. The susceptibility of steel to the influence of phosphorus and sulphur, of details of its heat treatment, and of other conditions occurring in the process of its manufacture, have resulted in restricting its production to the scrutiny of expert superintendence. Equal reason exists for, and commensurate advantages will follow, a thoroughly discriminating control of both the initial fabrication of concrete, and the details of treatment during its hardening, in order to realize the great possibilities inherent in this newer material.

The treatment of steel is not always complete as it comes from the rolls, as is shown by such effects as the changes in strength produced by the cold-twisting of steel rods; much more important in relation to the resulting quality of concrete is the nature of its treatment after fabrication, both because its attainment of strength is a relatively slow process and for the reason that the nature of the prevailing conditions provided during this

period affects so greatly the development of its essential properties.

The notable responsiveness of concrete to the character of its treatment is a direct appeal for thoroughly trustworthy and expert control.

DISCUSSION.

MR. J. W. WOERMANN. I would like to ask the Professor if some of those specimens were mixed real wet, like concrete is ordinarily mixed to-day, or whether they were all made from dry mixtures.

PROF. VAN ORNUM. They were all rather wet. Not so wet as the concrete used in buildings, but approaching that condition in all cases. They were not dry.

MR. J. W. WOERMANN. You did not have to tamp them!

PROF. VAN ORNUM. No, stirring was all it could take.

MR. MONT. SCHUYLER. I noticed that Prof. Van Ornum allowed his specimens to air-cure and then immersed them in water. Now that seems to me to be rather opposite from the condition you get in work where, if it is properly done, the concrete is sprinkled from the time it has begun to harden and before the load goes on, at which time the concrete is dried out. In other words, it is a reversal of regular work. The Water Department when constructing basins 7 and 8 had the laboratory test some specimens cast from the concrete. They all failed at very low figures, 500 to 600 pounds per square inch, in 30 days. In order to determine the effect of properly curing them, we kept the forms on as long as the wall forms were kept on and then stripped them when the wall forms were stripped, instead of stripping them as soon as the concrete was hard. The strength jumped to 1,200 pounds. Furthermore, certain specimens were kept in a moist closet for a week or so, and the strength jumped to 18,000 pounds. If they were kept in water until broken you would not get as high a strength as if they were kept in the mold until 2 or 3 days before finished and then broken. Those exposed 2 or 3 days were always stronger than those kept in water until broke. In other words, drying out seemed to strengthen them.

PROF. VAN ORNUM. I have had men from other testing laboratories try to question some of my results with their cements by bringing me briquettes that they had dried out and not kept in a moist closet until testing—dried out two or three days

before coming to me—and say they were the specimens to consider because they were stronger. In other words, these men and Mr. Schuyler, too, recognize the fact that manipulation of specimens in many ways gives different results, and you cannot standardize until you overcome those things. If a man cares to, in a laboratory he can get almost any result he wants to by the way he treats his specimens before he reads the weight on the scale beam in testing.

We have rather changed places. Mr. Schuyler has made a statement about the paper and I am going to ask him a question about it. Take the column of a building. Suppose that is dried out—has not been sprinkled, is cured in air. Suppose a heavy rain comes and soaks it while it is loaded. Isn't the load on it when it is saturated? I have said definitely and tried to make it as clear as I could, that the weakening comes at the time when air-cured concrete is completely saturated and if at that time it is subjected to a load, it may be 60 per cent of the load it ought to take, it will fail when otherwise it would not. How could I make better tests to develop the facts and show definitely that at the time of complete saturation the concrete is most weakened?

Mr. Schuyler. When you wet concrete it expands. If you take a concrete cylinder 16" long and 8" in diameter and soak it, the whole outside will be trying to get away from the inside, and some of the concrete will be carrying the weight and some will not. This is probably the cause of the weakening rather than the fact that the water is in there. Internal stresses therefore destroy the concrete before the real total strength of the concrete has been reached.

Prof. Van Ornum. Isn't wood weakened by sprinkling.

Mr. Schuyler. It may be due to the same cause.

Prof. Van Ornum. A wooden trestle is very much weaker after a long rain than it is in the dry season.

Mr. C. W. Martin. I read the report of this series of tests in the Proceedings of the American Society of Civil Engineers, and it called to my mind an experience I had with quickly cured concrete subjected to a severe wetting. It referred to concrete over a steel trough type bridge floor where the concrete was to act merely as a filler for waterproofing. In order to make the membrane waterproofing stick, our specifications required that the concrete should be kept as dry as possible. That is, we could not waterproof for two days succeeding a rain. The

concrete had to set for about four days in dry weather before we could waterproof, and several other conditions of that sort. One time a rain occurred after the concrete had been in about three days, and I noticed that a person could kick part of it off with his foot, while the day before it was hard. After that I watched it on similar occasions, and I found many cases where dry cured concrete (particularly in thin layers during hot weather) was subjected to a severe wetting that it would practically disintegrate. Of course, in that case the concrete merely acted as a base and no harmful results obtained, but I can imagine cases where it would. I can see very readily that in the column he refers to that condition might obtain. As far as Mr. Schuyler's argument goes about stresses, etc., that would take place in a column just as readily as in a specimen. The order in which Prof. Van Ornum conducted his tests is the only order that would show it up and is, as far as I know, entirely new, and the Engineering Profession should be very thankful that Prof. Van Ornum has furnished this information.

Mr. McCarthy. The question that comes to my mind is this. Suppose the columns have been thoroughly saturated and then dried out and then saturated, will the same conditions prevail as do on the first saturation?

Prof. Van Ornum. I do not dare do anything more than guess, and I hesitate to do that. I presume the same conditions would occur again, but to a less extent. I imagine that the loss of strength the second time would be less than it was the first, and the third time less than it was the second.

Mr. H. C. Toensfeldt. With our construction work in the hot weather, we find where we have large surfaces of concrete, such as are in a floor, that it becomes necessary to wet them down immediately. We use small lawn sprinklers and keep each floor wet for about 24 hours after it has been placed; then we usually take away the lawn sprinklers and let the concrete set on its own accord. Otherwise we find in hot weather that in a very few hours after the concrete has been placed it will develop huge shrinkage cracks. The only way to keep those cracks from forming is to keep the concrete wet. I do not believe that is covered by these experiments for the reason that these specimens are air dried specimens, for the first two days, while ours are water dried specimens for the first day, at least.

Mr. Hunter. I have had the same experience that Mr. Toensfeldt speaks of in boiler room floors, where we had to put bags on the floor to keep it wet all the time to prevent these shrinkage cracks. Where we gave it very careful attention the cracks would not appear.

Prof. Van Ornum. It is certainly essential to keep it wet for a day or two, especially in case of the top of floors which the sun reaches, and from which the evaporation is very great. The concrete is undoubtedly robbed of a considerable quantity of water which it needs for its proper setting, but whether this treatment would greatly affect this kind of result or not, I do not know. I rather suppose that the effect of a saturated condition would be much the same. I am fairly confident there would be a considerable loss of strength from specimens treated that way, but probably not so much for the reason that these specimens of mine were kept in the molds for the two days referred to, and, therefore, protected; not in the same way, by the sprinkling of water on them, but protected from the evaporation of water and from sunlight, so that I do not think the dissimilarity is such as to destroy the probability of a similar loss of strength of concrete sprinkled, or otherwise wetted for a day of two, were saturated after it had been dried for a month. Does not that seem reasonable?

Mr. J. W. Woermann. In your curve, what does that 100 per cent correspond to in pounds per square inch?

Prof. Van Ornum. About 16,000 pounds per square inch.

Mr. Woermann. In compression. How much in tension?

Prof. Van Ornum. In the vicinity of 180, I imagine.

Mr. H. C. Toensfeldt. Of course, most concrete in practice is subjected to exactly the condition, or very nearly the condition, that the Professor covers in his experiments. Suppose, for instance, you have a building where the floor below is completed and you have forms above and douse the concrete into them. It keeps the floor below them wet.

Prof. Van Ornum. To prevent the weakening you could sprinkle it all the time until it got its dousing.

By J. W. Woermann. (by letter). The writer desires to cite the failure of a large reinforced concrete chimney which was apparently an illustration of the principle annunciated by Professor Van Ornum.

The chimney referred to was built at Peoria, Ill., for the

Illinois Traction Company in the summer of 1906. Measured from the bottom of the foundation it had a height of 223 feet. Up to a point 92 feet from the bottom it had an outer shell 8 inches thick and an inner shell 4 inches thick, with a 4-inch air space between the two cylinders. At this elevation the outer shell was drawn in so as to maintain the inner diameter at 11 feet, and for the upper 125 feet the thickness of the shell was 6 inches. The failure occurred at this offset, which may have been inherently weak, but the crucial fact in this connection is that it had been standing for three weeks and failed at the end of a 24-hour rainfall; also that another chimney, exactly like it, 40 feet distant, which had been completed about *six weeks* did not fail.

Each batch of concrete consisted of 18 wheelbarrows of good sand and 18 sacks of a standard Portland cement, making 54 cubic feet of concrete, just enough to make one ring 3 feet high. As it required about two hours to haul up one of these batches, it is evident that the batches should have been smaller. A dry mixture was used so that each form might be removed at the end of 24 hours, and this resulted in a porous concrete which drank up the water like a sponge.

[NOTE—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

THE STATUS OF THE ENGINEER.

Discussion by F. G. Jonah, Member of the Engineers' Society of St. Louis.

[Vol. 52, page 4, January, 1914.]

The writer has read with interest Mr. Wall's valuable paper on "The Status of the Engineer." It has elicited a good discussion, and if there is anything wrong with the status of the engineer these discussions are the first step towards improvement.

While it has been true in the past that the work of the engineer was not appreciated at its full worth, the conditions are now rapidly changing. Hitherto the engineer has not been conspicuously in the public eye, but no profession is more so at the present time. No doubt the completion of the Panama Canal has had a great deal to do with this widespread recognition of the achievements of the Civil Engineer. Thousands of tourists from the United States have visited this work and have returned with words of admiration and wonder, the magazines and newspapers for the past five years have been full of illustrations and descriptions of the great work, and quite recently the illustrious Chief Engineer was the recipient of three gold medals in one week—one of them conferred by the President of the United States—in recognition of his work as a Civil Engineer.

There is apparent at the present time a widening field for the employment of engineers. The City-Manager plan of Dayton, Ohio, with its first incumbent a Civil Engineer, is giving the public a new viewpoint as to the capabilities and usefulness of our profession.

An engineer, a member of this club, has on two occasions acted as a Master in Chancery in important cases, which fact has recently received flattering editorial notice in the columns of the Engineering News.

The work of city planning and city building is becoming more and more the work of engineers. The type of construction of our large modern buildings is the work of engineers as much as the work of architects.

The writer does not agree with Mr. Smith that the profession is not represented fully in the higher positions on our railways. On the contrary, there is no other profession that

is contributing so many men to the more important executive positions. The *Railway Age Gazette* referred to this editorially on March 6, as follows:

Promotion of Engineers in Railway Service.

"There exists a general feeling among engineers in railway service that there is little opportunity for them for promotion into the operating department, and because of this feeling many engineers leave the railways to enter other lines of industry. While it is true that there is small opportunity for promotion on many roads, this condition is not universal and is growing less general. A glance through the announcements of promotions in our columns for the past few months will give much encouragement to engineers. For instance, in the last three months presidents have been selected for the New York Central Lines, the Atlantic Coast Line, the Northwestern Pacific, and the Nashville, Chattanooga & St. Louis, all of whom received their early training in the engineering department. Two vice-presidents with similar experience have been selected in the same period, as have also two general managers, one assistant general manager, one general superintendent and one assistant general superintendent. In the same interval nine division engineers and engineers of maintenance of way have been promoted to division superintendents of important roads, including the Pennsylvania Railroad, Pennsylvania Lines, Northern Pacific, Atlantic Coast Line, Central Railroad of New Jersey and Chesapeake & Ohio."

Since then a prominent American engineer has been made assistant to the president of the Canadian Northern.

In the more important matter of compensation the facts disclosed by the recent investigation of a committee in the American Society of Civil Engineers, shows that a very large number of engineers are receiving such salaries that they cannot be classed as underpaid.

Let the engineer rejoice in these facts: His work has never been as generally appreciated as at present; the opportunities for employment are widening with the complexity of modern civilization; his compensation is now more nearly commensurate with his work than ever before.

St. Louis, March 24, 1914.

OBITUARY

WILLIAM J. CROCKEN.

MEMBER OF THE ENGINEERS' CLUB OF ST. LOUIS.

William J. Crocken was born in Lexington, Va., February 6, 1857, and died January 30, 1914. He studied under a private tutor until he entered the Virginia Military Institute in 1874, graduating in 1878. Among his neighbors were General Lee and Stonewall Jackson, all members of the Methodist Episcopal Church.

After graduating, he taught French, Geography and Mathematics in a private college in California. He began to practice engineering in 1880, with the Denver & Rio Grande Railway in Colorado, being with them a year. He then spent two years each with the Georgetown, Blackhawk & Central City Railway (Union Pacific) on reconstruction and the Oregon Short Line; a short time with the Ohio Central in the Great Kanawha Valley; several years with the C., B. & Q. on its extensions into Kansas, Nebraska and South Dakota. One time he was in business in Seattle, Wash., and for a short time in Oklahoma.

William J. Crocken came to East St. Louis in 1895, and after serving several years as Assistant City Engineer was made City Engineer in 1904. As City Engineer he had charge of over $10,000,000 worth of public improvements, including a $750,000 outlet sewer system. He resigned in 1911 because of political changes. After this time, and until ill health overtook him in 1913, he had quite an extensive private practice.

He was married in 1890 in Seattle, Wash., to Catherine L. Auther, of Indianapolis, Ind. They had three children, the oldest dying in 1908, just before he graduated from high school. It was probably this death that started him on a decline, as he was unusually fond of his children.

In business he was a very politic, a good mathematician and grammarian, not easily excited and in general a first class man to work with.

He was a member of the St. Louis Engineers' Club, the Illinois Society of Engineers and Surveyors, the Elks' Club of East St. Louis and the Knights of Pythias.

T. N. JACOB.
W. A. THOMPSON.

FRANK PAUL MEDINA.

Member of the Technical Society of the Pacific Coast.

There passed away on June 27, 1913, Frank Paul Medina, Lawyer, Inventor and Musician; a man of deep technical knowledge along all lines of electricity. He was the inventor of a relay which overcame a difficulty hitherto considered insuperable by telegraphers, that is, the interval of no magnetism upon reversal of the signal. The invention fulfilled its purpose beautifully and was purchased and used for many years by the Postal Telegraph Company in San Francisco and Los Angeles. He also invented a dynamo for use in small plants, for the purpose of supplying several different potentials from the same machine; this he presented to the company and it was used with great success in Seattle until recently.

Frank Medina, as he was known, typified the joy of life. He was the spirit of exuberant youth carried into age. He was not old when he died and had he lived many more years he would not have been old. He was jocund existence and it was his sweet disposition brought him legions of friends. His musical genius, lightness of wit, and wsdom in deduction endeared him to all who knew him.

He was born in Calaveras County, California, in 1857.

His achievements were many and all useful to his fellow man, and while he did not accumulate much of the world's goods to pass on to his posterity, the world at large is much richer for his having lived.

He was descended of a noble Portuguese family. His father's immediate forbears were of the families Medina-y-Vasconcellos. Frank Paul Medina was a deep reader, a student of sociology, an ardent follower of Herbert Spencer, and the probability is that no one other had so deeply imbued in his nature the teachings of this great modern scholar.

To him the writings of Herbert Spencer embodied all that was worth while in all other systems of Philosophy, together with a saneness and deep scientific knowledge of the physical and mental phenomena of nature, and psychology which the others lacked. His great ambition was to spread the teachings of Herbert Spencer as widely as possible and to become known as the exponent and propagandist of the man who had so deeply influenced his own life and thought.

Frank Paul Medina.

Medina was a lawyer of note, well versed in general and patent law, and an expert in electrical litigation. He was a musician and composer, and his own compositions were of great brilliancy and merit.

He was the son of Frank Paul Medina and Phebe Kilborn.

He had been a telegraph operator, and at one time was train dispatcher, and was closely associated with the Postal Telegraph Company for many years.

Few men have such sound and diversified knowledge of things, and few scholars have succeeded with deep study in retaining until gray age, the sunny disposition of the rollicking boy. He is regretted by thousands.

Frank Medina's achievements in the line of electricity and the transmission of messages by wire and wireless are many. He had been consulting expert with many of those experimenting with wireless telegraphy and telephony. He was the expert and consulting attorney for the General Research Company in its work with wireless telephony, and his advice was sought by all who desired information along the more modern advance in electrical work. He was sought as an expert in electrical matters in litigation, because of his judicial and absolutely impartial position in matters electrical, and was recognized as the greatest of all the electrical experts on the Pacific Coast.

He was the author of many magazine articles on electricity published in English and American magazines, and his writings, as an exponent of the Spencerian philosophy, have been many, as well as his additions to current literature of the technical and philosophical. Of late years he had turned much of his attention as a publicist to social questions, and he was deeply concerned in a study of the modern political trend.

Standing nearly six feet, he was as straight as an Indian, and his face would have drawn attention in any assemblage. He had an aristocratic face and his voluminous hair crowned his head in a leonine mass. His appearance was impressive to a degree, and his voice carried conviction to his hearers because of the honesty of his argument.

He was never a partisan but, like Victor Hugo, he maintained that he preferred to be on the side of the loser, the weak, the side of the minority, because "the minority of to-

day leavened the mass and always became the majority of tomorrow."

A great deal of his legal work was a sort of unobtrusive charity, a kind that he could ill afford, but which he constantly practised. He was often imposed upon, not because he did not recognize the imposition, but because his good nature allowed it.

He loved the good in life. His greatest pleasure was in watching some process of Nature; he wooed wisdom in the cool of the woods; found solace in sun and moonshine; absorbed philosophy from the birds and the tiny animals of the forest. At all times he was cheek and jowl with Nature, a son of the earth, he loved it and everything upon it and under it. In his relaxations he was elemental and in his studies he was profound and one of the elect.

For two years he was lecturer at Stanford University on telegraphy and electricity. Among the students attending this course he was looked upon as a never-failing fount of wisdom, and his kindness and urbanity won him the friendship of many young men, a friendship which once gained he never lost.

The emanations of wisdom from his character, the sweetness of his many kindnesses, the unselfish devotion to his friends, will all pass on in an interminable evidence of his existence, an invisible and indestructible proof of his having lived a most useful life.

Possessed of a wonderful memory he had a remarkably fine delivery in elocution. His ability at extemporaneous verse-making was a gift vouchsafed to few men, and he was especially happy as a post-prandial speaker, the spirit of healthy gaiety permeated his remarks and his presence was sought as an enlivener of social gatherings.

He loved the redwoods of Mill Valley; there was his home and, losing himself in a view of distant bay and near mountain, his spirit would soar on the wings of poesy and his friends would sit enraptured at his words. There are some who were near and dear who believe his spirit still roams about the scenes he loved so much.

PIERRE N. BERINGER.

ANNUAL REPORT OF THE CHAIRMAN OF THE BOARD OF MANAGERS.

Ann Arbor, Mich., March 21, 1914.

To the Board of Managers of the Association of Engineering Societies:

Gentlemen: In accordance with the requirements of the Articles of Association, the Chairman submits an Annual Report for the year 1913. At the beginning of the year the Societies in the Association, their allotted representatives and mailing lists were as follows:

		Number of Journals sent
Engineers' Club of St. Louis, Mo.	4	375
Boston Society of Civil Engineers, Mass.	8	856
Civil Engineers' Society of St. Paul, Minn.	1	59
Montana Society of Engineers, Mont.	1	137
Technical Society of the Pacific Coast, Cal.	1	96
Detroit Engineering Society, Mich.	3	282
Louisiana Engineering Society, La.	1	175
Utah Society of Engineers, Utah	1	104
Oregon Society of Engineers, Ore.	2	190
	22	2,274

For several years the question of withdrawal from the Association had been considered by the Boston Society, but the older members had generally opposed the change and at the beginning of the year it was expected that their influence would be such as to keep the Society in the Association. This, however, proved to be a misconception, and on June 25, 1913, the Society by a vote of 226 to 158 out of a membership of about 800 decided to withdraw at the end of the year. This was followed in September by a vote of the Detroit Engineering Society of 250 to 8 in favor of withdrawal, out of a membership of about 450.

The Detroit Society having expressed a desire to remain in the Association until the close of its fiscal year March 31, 1914, by a vote of the Board of Managers permission was granted.

The withdrawal of the Boston Society rendered desirable the removal of the Secretary's Office from Boston, and as

the Engineers' Club of St. Louis was the largest Society remaining in the Association, a nomination from it of Mr. Joseph W. Peters, met with general approval, and at the election during November he was chosen Secretary for the ensuing two years from January 1, 1914. The undersigned, much to his personal regret, was re-elected Chairman, but as no other eligible candidate was proposed it seemed his duty to allow his name to be voted upon.

The Association begins the year 1914 with the following mailing list, according to the Secretary's records:

Engineers' Club of St. Louis	361
Civil Engineers' Society of St. Paul	64
Montana Society of Engineers	98
Technical Society of the Pacific Coast	87
Detroit Engineering Society	279
Louisiana Engineering Society	189
Utah Society of Engineers	127
Oregon Society of Engineers	66
Independent subscribers, exchanges, etc	307
	1,578

It is to be noticed that upon the withdrawal of the Detroit Engineering Society at the end of March, 1914, the mailing list of the Association will be about 1,300.

To the practicing engineer who has not access to a large library the concentration of the output of the several Engineering Societies in the country in a single publication is a great boon, and the reduction in membership of the Association is to be deplored. On the other hand, the publication of an individual journal where the Society is strong enough to support one appeals to local pride. The Engineering Societies of Philadelphia, Chicago, Pittsburgh and Brooklyn have maintained creditable publications of their own for several years, and there is little doubt that Boston will be added to the number. Cleveland has not done so well and it is to be doubted if Detroit will maintain a regular journal.

At the time the Association was formed, December 4, 1880, engineering literature was much less common than now. The National Societies were only distributing an annual volume

to their full membership. The engineering journals had none of them attained more than local prominence nor the strength to publish extensive articles. To the Association of Engineering Societies through the late Professor John B. Johnson, the profession owes the first general Engineering Index in this country, two volumes of which were issued by the Association covering the period from 1884 to 1895, and since continued by the Engineering Magazine.

The Officers of the Association has been as follows:

Chairman

Benezette Williams, Chicago, 1881 to 1893....	13 years
John B. Johnson, St. Louis, 1893 to 1895......	2 years
S. Everett Tinkham, Boston, 1896 and 1897	2 years
Geo. D. Shephardson, Minneapolis, 1898-1899	2 years
James Ritchie, Cleveland, 1900 to 1903........	4 years
Dexter Brackett, Boston, 1904 to 1907........	4 years
Gardner S. Williams, Detroit, 1908 to 1913..	6 years
	33 years

Secretary.*

Henry G. Prout, New York, 1881 to 1887....	7 years
Railroad Gazette, New York, 1887 to 1890..	2 years
John W. Weston, Chicago, 1890 to 1893......	4 years
John C. Trautwine, Jr., Philadelphia, 1893 to 1905	11 years
Fred Brooks, Boston, 1905 to 1913................	9 years

The following Societies have been members of the Association for the periods indicated:

Engineers' Club of St. Louis, Jan. 5, 1881 to date.

Civil Engineers' Club of Cleveland, Jan. 8, 1881, to March 1908.

Boston Society of Civil Engineers, Jan. 19, 1881, to Dec., 1913.

Western Society of Engineers, (Chicago), April 5, 1881, to Dec., 1895. Original membership less than 500.

Engineers' Club of Minneapolis, July, 1884, to June, 1907.

Civil Engineers' Society of St. Paul, Dec., 1884, to date

Engineers' Club of Kansas City, Jan., 1887, to 1896.

*The terms of service are given to the nearest year.

Montana Society of Civil Engineers, April, 1888, to date.

Wisconsin Polytechnic Society, June, 1892, to March, 1894.

Association of Engineers of Virginia, Feb., 1895, to 1898.

Denver Society of Civil Engineers, Jan., 1895, to 1898.

Technical Society of the Pacific Coast, March, 1895, to date.

Detroit Engineering Society, Jan., 1897, to date.†

Engineers' Society of Western New York, Jan., 1898, to Dec., 1906.

Louisiana Engineering Society, Sept., 1898, to date.

Engineers' Club of Cincinnati, Jan., 1899, to Jan., 1902.

Toledo Society of Engineers, Jan., 1904, to Sept., 1908.

Engineers' Society of Milwaukee, April, 1908, to Sept., 1910.

Utah Society of Engineers, May, 1908, to date.

Oregon Society of Engineers, Nov., 1911, to date.

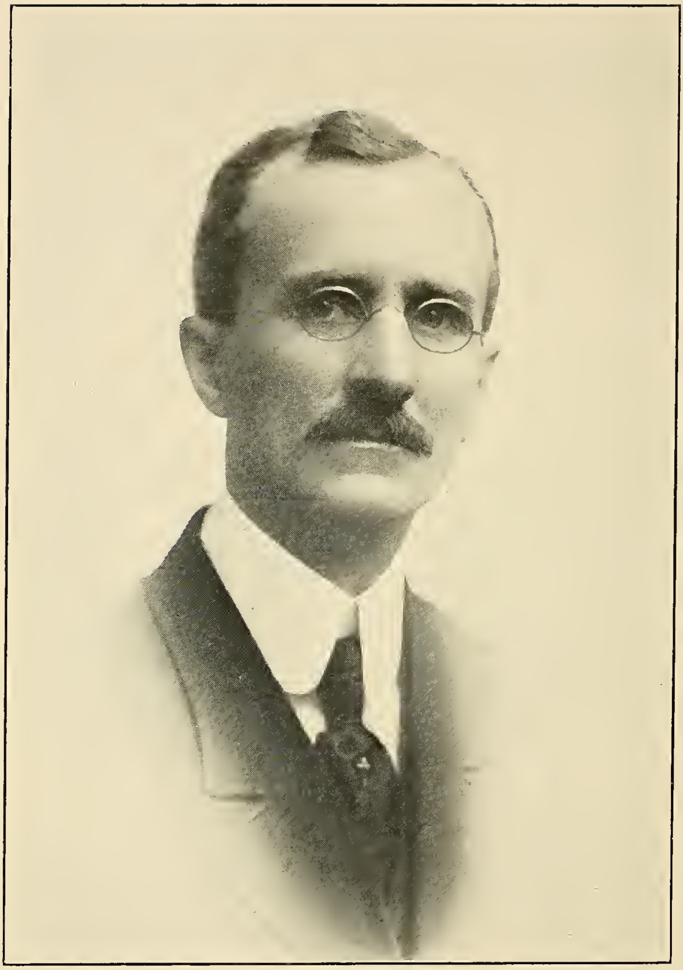
For the early history of the Association reference may be made to the Report of President John B. Johnson, in the Journal for January, 1895.

All of which is respectfully submitted.

GARDNER S. WILLIAMS, *Chairman.*

†Will withdraw March 31, 1914.

A. P. Greensfelder,
President of The Engineers' Club of St. Louis.



JOHN W. WOERMAN,
Chairman of the Board of Managers, Association of Engineering Societies.

Editors reprinting articles from this JOURNAL are requested to credit the author, the JOURNAL OF THE ASSOCIATION, and the Society before which such articles were read.

ASSOCIATION ENGINEERING SOCIETIES

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THE COMMISSION-MANAGER FORM OF GOVERNMENT.

BY HENRY M. WAITE, CITY MANAGER OF DAYTON, OHIO.

[Read before the Engineers' Club of St. Louis, February 27, 1914.]

The Commission-Manager form of government in Dayton, is the application of the newest development in organization to a municipality. The Commission is elected by the people on a non-partisan and short ballot. The man receiving the highest number of votes is the mayor. These five commissioners represent the Board of Directors of a corporation, and they select and appoint an executive, who is the city manager. He is absolutely responsible for the running of the city. All the functions of the municipal government come under the city manager, outside of the legislative functions, which are in the hands of the Commission. The organization chart of Dayton is quite interesting, being based on the pyramidal form with five points. There are five commissioners as the legislative body who employ the city manager, or executive, and under him are the five operating departments.

There has been a general awakening all over the country to the fact that a change in our municipal form of government is necessary, and various forms of organization have been recom-

mended and adopted in different parts of the country, but all are trending toward a more centralized power. The organization below the executive, varies in various communities in accordance with the ideas and the conditions existing and as to whether or not the people themselves are ready for radical changes.

The form of the Dayton organization is interesting because the President of the Charter Commission was Mr. Patterson, President of the National Cash Register Company. Mr. Patterson in all of his organization charts, carries out the idea of five departments, or a multiple of five. If he works a chart into fourteen sub-divisions, he will keep at it until he gets fifteen, or go back to ten. Each of the five departments under the executive in Dayton, is headed by a director and each of these directors is appointed by the city manager. The Director of Safety has charge of the police, fire department and weights and measures. The Director of Service, has charge of the water works, engineering, the construction, repairing and cleaning of streets and sewers, the collection of garbage and ashes, and the general supervision of all public utilities. The Director of Finance has under him the treasurer, the accountant, and the purchasing agent. The Director of Welfare has all correctional institutions, hospitals, charities, parks, playgrounds, recreations, outdoor relief, social betterment and all community and social features. The Director of Law is the city attorney.

The appointment of these directors is the first step in the application of business methods to municipal government. Our Director of Law is one of the leading attorneys of Dayton. He was on the original charter commission and had more to do than anyone else with the drafting of the charter. He accepted the position at a sacrifice to his own business.

The Director of Welfare is a minister. He is an executive. He was at the head of a very large parish, and is a man who was doing a wonderful work outside of his church. He had made studies of social conditions and social betterment; had travelled abroad and studied conditions in foreign cities, as well as in the cities in this country, his greatest work being done outside of his church. He accepted the position of Director of Welfare and resigned from his church. The Director of Finance is a man from Dayton who had occupied in the various industries of Dayton the positions of accountant, purchasing agent and treasurer.

When he was appointed, he was a member of a firm of public accountants.

The Director of Service is a man from out of Dayton. When it came to the appointment of the various directors, the commission and myself got together and they furnished me lists of the men whom they thought had the characteristics and experience to fill the various positions. On the position of the Director of Service, however, they thought it advisable to bring a man from out of town, and so I selected a man who had had large construction experience, had been on the new aqueduct in New York, who had studied municipal work in general and who had been my principal assistant engineer in Cincinnati.

The directorship of Safety has never been filled, as we were not able to find the right man and the city manager is now filling that position.

These directors, with the city manager, form the staff, and they meet every day for an hour and go over the important questions in each department, the same as you would do in your own business. If there is a division of ideas in these staff meetings, a vote is taken and while this particular function is not called for in the charter, it centralizes the entire organization.

Each director is responsible for his own department. Each director makes his own appointments, subject to the approval of the city manager, and the question of appointments is taken up at the staff meetings.

The Commissioners, together with the city manager and the Director of Finance as Secretary, form the sinking fund trustees. This brings all of the finances of the government inside of the central organization.

I think that every one will agree that there has been an awakening all over the country as to the inefficiency of the old form of municipal governments, and we ourselves, the voters, make the conditions what they are. We may be dissatisfied at what is being accomplished, but as a matter of fact, we are responsible. We have allowed innumerable laws and statutes to be passed which surround municipal work with a net-work of red-tape, making progress and efficiency impossible. We, to protect our communities and ourselves (as we thought) allowed these laws to be passed, and there we ended our interest in municipal affairs. We elected people to office and then hampered them,

then condemned them. I have thought, since I have been in municipal work that if it was possible to get one of those public jobs in the open where we could handle it as our big businesses are handled, most remarkable showings could be made. Unfortunately, however, it is impossible, due to the net-work of laws and the attitude of the people, to get efficiency rapidly.

Take any city organization and analyze it. How could any man operate his own business with the organizations which we have allowed in our governmental affairs. We have all kinds and conditions of individuality; some departments are run by boards and commissions; some are elected and on some of our boards one is elected and the others appointed by some one else. In some cities the governor may appoint some of the boards. How can any man operate any business with the organization which we have handed over to him to operate under? It is absolutely impossible to get efficiency.

Whenever there is a political overthrow, the entire organization is usually wiped out, and a new one put in. What private business could stand such an operation? The continuation of affairs on our part has built up political machines, run by a centralized power, and we ourselves have done it. We have not in our governmental organizations, allowed for any centralized power, and as we know in our own business that centralization is essential, the political parties themselves have centralized around a boss, and we have allowed our cities to be governed by two parties, one party in power and entrenched, and the other party on the outside waiting for an opportunity to become entrenched. Our idea of municipal reform has been to throw out one party and put in the other. We have allowed these party organizations, one in and one out, to be moulded under our very hands. Their strength lies in organization, and centralized power. The boss holds his organization together with the idea that "to the victor belongs the spoils." We often hear that the city manager is nothing more than a boss, or centralized power. This may be true to a certain extent, but the conditions are not comparable, as under the old form of bossism, the boss was unassailable; he was unofficial. Under the city manager form, the "boss" is assailable because he is an official, and under our particular charter in Dayton, the city manager is subject to recall.

The general awakening of the American Republic to our

municipal affairs is, to my mind, one of the best signs we have had, because it means that we are going to start at the bottom and work up. In foreign cities the municipal governments were the original governments which spread into provinces, and the provinces into the nations. In this country, it has been the reverse. It started with our national government and worked into states, and then cities. Now we are proceeding to build up our municipal governments.

There is such an awakening in this country at the present time on the question of municipal government that we fear that too many will be rushing in to unproved forms before they are ready. Dayton was well prepared for the change. Over two years ago, there was started, through public subscription, the Bureau of Municipal Research which made impartial investigations into each department of the city, and worked up a wonderful fund of data and caused many beneficial changes. It was constructive in its attitude, not destructive. It is the same procedure that is carried on in business corporations, but which has never been generally done in our municipal governments.

The people of a community must be educated up to a change. A few people cannot rise in their wrath and establish a new order without the support of the masses. The results of a municipal bureau of research are absolutely necessary for three reasons. First: They compile data which shows the people the necessity of a change. Second: After the change has occurred, the information and experience of the bureau is necessary for the installation of the new government. Third: The information which the bureau has gathered together, is necessary as a basis of comparison, after the new government has been established, so that the new can be compared with the old.

There is a general idea throughout the country that Dayton did not start its campaign for a change of government until after the high water. This is not true. They had started this research a year before, and a committee was organized in January to determine upon the method of procedure. Undoubtedly the high water caused the people to be drawn closer together, and aided in the rapid developments which have taken place in the change of government since the flood. We have one organization in Dayton which comprises about five thousand people. This out of a population of 125,000 and it is heart and soul be-

hind the new charter. In addition to that, during the campaign, a Citizens' Committee was built up from a regular ward and precinct organization and this is used as an educational organization to get information to the people. This educational matter was prepared by the Board of Municipal Research. This same organization got the people to the polls. From this you will note that there is considerable work necessary before any change in government is attempted. I should like to call the following very important point to your attention, and it is one I think the American people have lost sight of, but are now beginning to grasp: That it makes absolutely no difference what particular form of government the city may have, if the people themselves are not interested in it, and participate in it, that government will never be a success.

In closing, I should like to change an erroneous impression that is in your minds, which I have met everywhere, and also in St. Louis, that Dayton needs sympathy. People seem to feel that my particular task is to rejuvenate Dayton from the effects of the flood. Gentlemen, Dayton does not need sympathy to-day. There are no signs in Dayton of the past flood. Its physical condition is good. To my mind, Dayton needs commendation for what it has done, and not sympathy.

DISCUSSION.

Mr. J. W. Woermann. May I ask a question please? What do the Commissioners do in Dayton. I heard you say they were the legislative body, but will you give us a little more light on what they do and how they do it?

Mr. Waite. The Commissioners are the legislative body; they must pass all ordinances. They have to pass upon all questions of policy in regard to improvements. They have to furnish the money. That is, they have to pass the necessary legislation for the money. The action of the Commissioners, I might say, is just the same as the Board of Directors.

Mr. Philip Moore. Are they supposed to devote their whole time to it?

Mr. Waite. No, about three or four hours a week.

Mr. Moore. Are they paid?

Mr. Waite Yes, and there is considerable "jealousy" in the Board of Directors. Each Commissioner receives $1,200, and

the Mayor, because he receives the largest number of votes, gets $1,800, and they are always throwing up to the Mayor that he is the man that ought to go to the extra expense, because he gets $600 more. If a new improvement comes before the Commission, it is immediately referred to the City Manager for investigation and report, and if the City Manager reports favorably after investigation, they then authorize the Manager to prepare an estimate, and then it proceeds the same as it does in any other ordinary city government. Our charter requires that any expenditure of money for which bonds are issued must stand for thirty days to allow referendum. I will be very glad to go more into detail, if that is not sufficient.

Mr. E. R. Kinsey. I am not quite ready to say that I think St. Louis needs a city manager, but we certainly need some official or board in authority with the latitude of a city manager. In relation to the administration of engineering and construction matters, our city has been fortunate in past years. For many years we have had Boards of Public Improvements composed of men of the highest standing, of great efficiency—whose service to the public has been such that one would hesitate to suggest any radical change in that feature of our government, though there is no question but what that Board could operate much more efficiently if it were given more latitude—more power to do things when they should be done, rather than wait until the next year.

I have no doubt that Mr. Waite feels that it is good business to offer salaries which will bring to his assistance men of the caliber that he desires. I am very much in hopes that our Board of Freeholders now working on our charter will so frame it as to enable us to work out some of these problems along lines parallel to those of Dayton. I think the members of the Engineers' Club will all join me in that hope.

Mr. Maxine Reber. The great question that confronts us at this time is, what can be done to get under the apathy and the indifference of the average voter? As has been said this evening, those substantial reforms in municipal methods, which have resulted in simplicity, efficiency, economy and expedition have usually followed some catastrophe. It seems to take something unusual—some shock, some catastrophe, to wake us up to the necessity for changing conditions.

The ordinary man is, in general, a pretty decent fellow who wants to do the right thing; but he is occupied with his business, commercial, industrial and social affairs, and depends for his information as to what is going on in a general way upon what he sees in the press. He has no opportunity of easily getting dependable, accurate information; and my experience in the several years during which it was my privilege to be in public affairs was that a large amount of our difficulties, our trials, the patent ineptitudes and the inefficiencies was due to the lack of knowledge the people have about their own municipal affairs. That seems to me the great problem that confronts us to-day—how are you going to hammer into the people the need for changes.

Undoubtedly, men such as compose this body, who have accurate knowledge along those lines, can be most effective in helping to bring about new results. What we have heard to-night is not only what can be, but what has been done, and the possibilities that have been developed by a brother engineer I think are most encouraging, professionally, to all of us. It is certainly inspiring work that has practically been accomplished; and leads us to hope that if we can pull together, we ourselves may accomplish something along those same general lines.

Mr. Julius Pitzman. My observation of the government of our City extends over a period of fifty years, and I find that it is not of so much importance to have the laws for governing a city prescribe all details as it is to get the proper men to administer the laws.

Our Charter has given general satisfaction and this may be attributed to the fact that immediately after the Charter was adopted by the City of St. Louis we had an opportunity to procure the services of Mr. Henry Flad as President of the Board of Public Improvements, and through his influence four other excellent engineers were selected as chiefs of departments, to-wit: Mr. John Turner, Street Commissioner; Mr. Robert Moore, Sewer Commissioner; Mr. Thomas Whitmann, Water Commissioner, and Mr. Karl Pfeiffer, Harbor Commissioner. Mr. Overstolz was Mayor. He had served for many years as Comptroller and had considerable experience in city affairs and was ably assisted by Mr. Leverett Bell as Counsellor. It was due to their work that broad foundations were laid for a good government. If the same Charter had fallen into the hands of incompetent or

corrupt men, the result might have been very different. They adopted rules and had ordinances passed under which the City was to be governed.

Corruption in government in American cities, as a general thing, can always be traced to the legislative department. I am satisfied from my experience, that where there is one dollar misappropriated or stolen by the officers of the executive department, there are ten dollars misappropriated or lost by acts of the legislative department. When you have thirteen men in the Council and twenty-eight in the House of Delegates, you divide the responsibility and careless legislation is the result. They cannot go into all questions brought before them carefully, and it would be a great deal better, in my humble opinion, to vest larger powers in the executive officers.

I am opposed to placing in the City Council the power to approve the appointees of the Mayor, because under our present system, the Mayor, in most cases, in order to have his slate confirmed, must appoint men who have friends in the Council, and the result generally is a compromise.

I think it will prove a very dangerous experiment to submit a large number of questions to the voters at a given election. If we submit one or two questions to the voters, we may obtain an intelligent response, but not otherwise. If you vest great powers in the Mayor, make provisions for the recall, and hold the Mayor responsible for his acts, it seems to me that we will probably have good results.

Mr. W. A. Layman. As I listened to the speaker to-night, it occurred to me that it was quite appropriate that an engineer should be one of the first City Managers in the United States. In such a position, the public demands two things: first, expert service; second, absolute honesty.

I think I may fairly say the engineering profession combines these essential qualifications, as does no other. The constructive business of the great modern city is largely engineering in character, and the trained engineer is pre-eminently the man best qualified to direct these constructive movements.

As to integrity of character, I think it may also be said that the engineer, on the average, is perhaps a little more honest than those of other professions. At least, it may be said that his in-

dividual training has had the emphasis placed upon honesty to a degree that is not true of many other professions. If the engineer, as an individual, has yielded himself successfully for four or five years to a university training, of which the first essential is honesty—if he has had the personal character to withstand such a type of training—he offers the promise of going into public service, as an essentially honest man.

So far as the engineering executive goes, it does not necessarily follow that he will be a success because of his training, or the character of his profession. I am of the opinion that executive ability is largely an inborn qualification. If a man has this innate quality in his makeup, then his engineering training probably gives him some advantage over the ordinary man in the development of that qualification.

Another advantage the engineer will have as a City Manager, is that he has been trained to respect expert opinion. If he is thrown into a position where a great variety of expert opinion is called for, he will rely upon the experience of others, in all those directions where his own training and experience have been limited.

In business fields, the engineer is more and more, in my judgment, drifting into positions of authority, and for the young man looking forward to a strictly business career, an engineering education is about the best education he can have.

I trust and believe that if the City of St. Louis, in formulating its new Charter, creates a position analogous to that which Mr. Waite occupies in Dayton, an engineer will be called to occupy it.

Mr. Waite. On my way to New York a short time ago, I was asked by some friends who were going to have a dinner, if I would not give them a talk on the Dayton charter; but I hadn't time to write many speeches (as we only put in eighteen or twenty hours a day in Dayton) and I was making up a little lost sleep going on East, but I thought I had a wonderful subject—"the awakening of the engineer." I started out on it all right, but I only had an hour and knew I could not do it justice, so I gave it up; but I believe that right now is the time when there is a possibility for the engineer to get to what really is his own. An engineer by training and also by education, is retiring. An engineer has usually some problem to work out, and usually the

very nature of that problem requires a shunning, a getting away from publicity. He must retire. His report, whatever it may be, cannot be known by the public, usually, until it is acted upon by some one else. For years, I found that I could write a report fairly well, but could not get up and explain that paper or that report. I was always scared to death. I never will forget the first time I was called before a Board of Directors. I thought for a great many years that that was a personal weakness on my part, and I never mentioned it. I was ashamed of it, but found later that it is a characteristic of engineers. To-day, a newspaper reporter will scare me to death. Of course, my railroad training kept me away from it, and I cannot get used to it. To my mind, the engineer's training is the very thing that we want in this country to-day. As Mr. Layman said, an engineer's aim in working out a problem, is efficiency and economy, and that is true in every field that you put him into; but we go along in our own little narrow way, and do not generalize; therefore, we are not preparing ourselves for the positions that are really open to us. I think it is due not only to our training and experience, but to our education. When I was in college I never had to get up and talk. Everything was written. You might have gotten up in a class, but you never had the opportunity of getting up and making your proposition in public; or, if you did, it was just one specific problem. Colleges do not make us generalize enough, and we continue in the rut through life. An engineer naturally concentrates—he knows how to concentrate—he is trained in efficiency, economy and concentration. If he could add generalization, the engineers would be employing lawyers instead of the lawyers employing the engineers.

I thank you.

Mr. Philip Moore. I think that this Club can only recognize the very illuminating address of the distinguished experimenter by a rising vote. I move this Club express its thanks to the speaker by a rising vote.

[Note—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the Journal.]

TIMBER CONSERVATION AND PRESERVATION IN THE UNITED STATES.

By E. L. Powell.

[Read before the Louisiana Engineering Society, March 9, 1914.]

Taxation must be carefully considered and its relation to the forests determined before a general plan of re-forestation can be laid out. A complete revision of our taxing system as it relates to forest lands must be considered and made effective. Timber must be considered as a crop and when determining its taxable value, we must remember the fact that the crop cannot be harvested at frequent intervals, but that the harvest time will be about once in thirty years for quick growing timbers and for the hard woods, perhaps once in fifty years. The rate of increase in value by growth of timber is not sufficient to pay for the care of the forest, interest on the money invested in the land and the growing crop, and in addition taxes at current rates. The interest on the taxes alone would, in many instances amount to the full value of the crop of timber when harvested. Land upon which timber is growing, or land when set aside to be planted with timber, should be entirely exempt from taxation and all timber should be taxed when cut and marketed. As the tax laws are at present, the owner is practically forced to cut and market his timber as soon as it is large enough to sell, even at a low price, thus absolutely placing a premium upon the cutting, or rather forcing the owners to do that which they should not do. In European countries, the problem has been solved by the Government taking over and controlling the forest lands, thus providing the necessary money for the ownership and growing expenses out of the public purse. Being publicly owned, there are no taxes and in this way, even such thickly settled countries as Germany and France, are to a very large extent producing their own timber and at reasonable prices. In our country there was at first an apparently inexhaustible supply of fine timber and it was customary in clearing lands for agricultural purposes, to destroy annually millions of dollars' worth of fine forests. With the increase in the population of the

United States, conditions have rapidly changed, until at the present time, it is estimated that the supply of timber for building and structural purposes will be practically exhausted in fifty years.

The rapid deforestation of the plateaus and mountain sides has also brought about serious problems that are taxing the ingenuity of the engineers to correct and control. The floods that have been of so frequent occurrence with the last few years and are brought so close to the people living along the great rivers are, to a large extent caused by the fact that the high lands are no longer covered with forests to provide the necessary spongy soil or humus to hold back the rain fall. It will never be possible to reforest sufficient areas to control the floods and they must be controlled in other ways. However, there is a vast acreage admirably suited for the production of timber under proper conditions and of very little value for other purposes. A supply of good lasting cheap building material is of vital importance and unquestionably this need is best supplied by the forests. Men with families and of moderate means should be encouraged to own their homes and this cannot be brought about with high-priced building material requiring the services of high-priced skilled mechanics.

A wooden house is easily and quickly constructed and at a very moderate cost compared with brick, steel and concrete structures. All of the substitutes for timber cost more money and are, therefore, less available for the poorer classes. The people of to-day owe to posterity the duty of preserving to them an ample supply of timber for the various and many purposes for which timber is required. This is a duty that should not be shirked or postponed. Everywhere by leaps and bounds we are reducing the available supply, making the duty more difficult, while practically nothing is really being done. The yellow pine forests of the south and the great fir forests of the northwest are now supplying, and in the near future must supply the great portion of the timber required. At present the timber cut per annum amounts to about forty billion feet board measure, equivalent to about three million carloads per annum.

The various steam and electric railroads are using about one hundred and fifty million cross-ties per year. Telephone, telegraph and electrical companies are using about four million

poles per year, while the fire waste is enormous. Heretofore the cross-ties have been cut principally from the best varieties of timber, such as white oak, heart long leaf yellow pine, chestnut and cedar: poles have been of chestnut, white and red cedar. It is estimated that a white oak tree will grow large enough to make five or six ties in 60 years, while 190 years is required to grow a cedar pole 25 feet long and 7 inches in diameter at the small end, so that any attempt at producing such timbers is bound to be entirely for the benefit of future generations. While it is true that the supply of our best construction timbers is being rapidly depleted, there are, at present enormous quantities of inferior timbers, that is timbers with little decay resisting powers, such as the several species of gum, loblolly and second growth pines, red oak, water oak, hackberry, etc. These timbers at present little used, except for fire wood, could, by preservative treatment be given a longer life than is now obtained from our best untreated timbers. What then is necessary? Gentlemen, the solution of the problem is in the hands of the Engineers and Architects as it will never be solved by the general public, who know little or nothing of such matters. You must teach the people what to use and write your specifications so as to secure the best results in the use of our timber supplies. Educate the people, *your customers,* and make them realize the benefits they can secure by the expenditure of a little more money. While we are interested in the future, we are also vitally interested in the questions of to-day and this matter of timber supply affects us also.

The most feasible method of increasing the supply of timber appears to be the adoption of some method by which the useful life of the wood will be materially increased and with this in view, experiments in wood preservation have been going on with more or less success during the last 100 years. At the present time, the efficacy of wood preserving is no longer doubted by those familiar with the work. It is practicable to treat and thereby preserve practically all timbers in a very effective manner and at a very reasonable increase in the cost of the finished material. It is now possible to preserve all lumber used for house building purposes, even inside work, so that while the timber is preserved against decay and protected against the attacks of the wood destroying insects, the color and finish of the

timber will be unchanged and the treated timber can be varnished, stained or painted in any manner or by any method that can be applied to the ornamentation of the untreated timber. There are quite a number of wood preservatives, such as bi-chloride of mercury, sulphate of copper, chloride of zinc, or chloride of zinc combined with salts of aluminum, all good when used properly, and when the treated timber is used under suitable conditions. No other preservative, however, has yet been found so universally effective, under all conditions as creosote oil. This is the preservative most extensively employed. The use of creosote oil as a wood preservative has long since past the experimental stage and it now has behind it the record of 100 years steadily increasing use. There are many creosoting plants or works in Europe, and the industry there is of long standing and is well established. In the United States, 15 years ago, there were perhaps ten wood preserving plants in operation: to-day, there are 94 such plants, each capable of treating or preserving perhaps an average of 30 million feet board measure per annum. Their work has been largely for the big companies, such as railroad and port companies, the products being piling and timber used in construction of bridges, trestles and wharves, cross-ties, cross-arms, poles and for other purposes where the structures are constantly exposed to the elements. Creosote oil is not a manufactured article, but is a by-product of the distillation of coal tar, which is itself a by-product of the manufacture of gas and coke. The supply is necessarily limited by the amount of coal used in the manufacture of these two articles, and, therefore, the supply of coal tar cannot be increased at will. It is not profitable to distill tar for creosote oil alone and this still further limits the product. The growing use of tar for paving purposes and in the manufacture of roofing material is increasing the demand for pitch and this will naturally increase the supply of creosote oil. The United States is producing about 27 per cent of the creosote oil used in its wood preserving, the balance, or 73 per cent, being imported from Europe. As the demand for tar products increases, by-product recovery plants are being installed in the coking regions and the tar that now burns or goes to waste in the form of gas is being saved to an extent that it is increasing yearly. When this waste is entirely prevented and all tar saved, it is believed by many that the United States will produce enough creosote oil for its wood preserving purposes,

but these estimates are, in my opinion, wrong, as they fail to take note of the rapidly increasing use of preserved timber, so that the problem of wood preserving is now, and I think always will be, to secure the very best results with the least amount of creosote oil that will accomplish the purpose.

In the process of preserving timber by use of creosote oil, or as it is commonly called, "creosoting," the wood may be divided into two classes, "air seasoned" or dry timber and "green timber." The methods of preserving these two classes, while similar in some respects, vary materially in others. The modern creosoting plant consists of steel cylinders adapted to withstand heavy pressures, pumps, tanks, cranes for handling timber, etc. All cylinders and tanks are equipped with proper gauges and thermometers and there is also provided a completely equipped laboratory for making chemical tests of the materials. These cylinders vary in diameter from 6 ft to 9½ ft. and in length from 60 ft. to 200 ft. according to the amount of business or work done, and some of the installations are very extensive. In carrying out the process of creosoting the green timber is loaded on trucks or carriages and pulled into the cylinders, the doors are then closed tightly and the timber is steamed at such temperatures, not to exceed 285 degrees F., and for such periods of steaming as the condition of the timber may require. When the steaming is completed and the steam has been allowed to escape from the cylinder or retort, the timber is further seasoned by the use of a vacuum pump. These pumps are of large capacity and rapidly exhaust the moisture and sap. The oil is then admitted to the cylinders and the required amount forced into the timber under heavy pressure. The amount of oil actually injected into the timber is determined by accurate gauges. The surplus oil is returned to the tank from which it was taken and the first and last reading of the gauge absolutely determines the quantity of oil used. This applies to the treating of green timber, but when dry timber is treated, the steaming is omitted. With all of the other preservatives the process is very much the same, as far as the handling of the timber and preservative is concerned.

Naturally, the question arises in your mind, does creosoting accomplish the desired result and does it pay? These are vital questions. In regard to the results, I can only point to the numerous examples of structures built of creosoted timber that

have stood the test of time successfully. You are familiar with the bridges along the Louisville and Nashville Railroad, between New Orleans and Mobile, built of timber creosoted in 1876-77-78 and 79. These structures have been repaired from time to time, on account of storm damage, but the decay has been practically nothing. The bridge of the New Orleans and Northeastern Railroad, across Lake Pontchartrain is now about 30 years old, was built of creosoted timber and is in fine condition to-day, and will be serviceable for many years to come. The telephone pole line along the Louisville and Nashville Railroad was built in 1898 of creosoted poles and these poles have certainly been exposed to the most unfavorable conditions, yet out of 12,000 poles, only one pole has been removed on account of decay and four or five removed on account of fire damage. In the construction of its telephone lines in Louisiana and Mississippi, the Cumberland Telephone and Telegraph Company has used about 185,000 creosoted pine poles, beginning their use in 1899, and up to the present time there have been removed for all causes about 1-9 of 1 per cent, and this includes not only the poles removed on account of decay, but poles removed on account of damage by fire, lightning and wind storms. Truly, this is a remarkable record. All of the structures above mentioned were built of timber which, if untreated, would not have lasted two years. The marine ship worms or teredo that are found in the waters of the Mississippi Sound and Lake Pontchartrain, will destroy all untreated timber in six or eight months, while decay alone would have destroyed it in two years or less time. It is believed that the poles mentioned will give a useful life averaging 40 years; in other words, the life will be multiplied by 20 by the preserving process. I have mentioned these instances that are close at hand—many others can be cited.

Attention is called to the creosoted wood paving blocks laid 28 years ago in Galveston, Texas, and a small lot laid 38 years ago in the same city. I had the pleasure of personally examining a number of these blocks about six months ago and found them perfectly preserved and sound. Creosoted timber, therefore, can undoubtedly be relied upon and when the cost of the untreated timber plus the cost of the construction divided by the annual life is compared with the result obtained in the same way for creosoted material, the question of doubt as to the advis-

ability of using preserved timber will disappear. I desire to call your attention especially to a method of construction now in daily use in our city, and which, in my opinion, deserves your most serious consideration and prompt attention. I refer to the use of untreated timber, piling and lumber in foundation work. Wood submerged in fresh water will last indefinitely, for the water is an effective seal against the spores of decay and also preserves the timber against such wood destroying insects as are found on land. Fifteen years ago, under the conditions existing at that time, it was perfectly safe to use untreated timber for foundations, but these conditions have materially changed since that date and are changing daily. The water line in the soil is being steadily lowered by the extension of the sewerage and drainage systems, assisted by the conduits of the telephone and telegraph and electrical companies. This underground drainage carries away a vast quantity of water that formerly remained in the soil. The city is rapidly building up and is also extending its paved area, thus providing a quick run-off for the rain fall and lessening the amount that penetrates the soil. Fifteen years ago an excavation 3 ft. deep almost anywhere in the city of New Orleans would fill with water very quickly, but you are familiar with the fact that large excavations can now be made to a considerable depth without encountering much water. This removal of moisture from the soil permits decay, so that structures on untreated foundations will certainly become unsafe and the engineers will have before them the problem of putting foundations under such existing structures. This work will necessarily be expensive and steps should be taken now to correct the bad practice. Untreated timber may be used for any foundation work below the permanent water line, but above that line foundations should be of concrete or preserved timber.

About six months ago, our daily papers called attention to the condition of the St. Louis Cathedral, one of our most valued historic structures. The foundations were reported decaying and giving way—very probably the decaying foundation piles or crib work. In this instance, the subsidence has been gradual. Picture to yourselves what might be the result of the foundations of some of our fourteen-story office buildings failing, perhaps at a time when the building was filled with workers. Gentlemen, the very thought of such a catastrophe is appalling, and should such a

thing occur, think what it would cost us! It is now possible to inject large quantities of creosote oil into piling and timbers and afterward recover 50 to 60 per cent of the amount injected, thereby reducing the cost materially. Your attention is called to the creosoted piling foundation recently placed for the new Henderson Sugar Refinery and the fact that the City of New Orleans, in the construction of the buildings of the Sewerage and Water Department, is using creosoted piling foundations. Aside from any personal interest in the matter, I believe the use of untreated timber in foundation work above the permanent water line should be prohibited by law, and this is very seriously recommended for your consideration. Attention is called to the advantage of using creosoted timbers in house construction, such as sills and joists and to the many troubles caused by decaying foundations, such as cracked plastering, leaky roofs, etc.

Doubtless all of you remember when the sales and livery stables were built by the Frisco Railroad out on Bienville Street. I do not believe these buildings are ten years old, yet within the last few months, the fifth floor of 3 inch timbers was relaid in these stables, an average of less than two years per floor. A floor of properly preserved timber would last until worn out and give a useful life of 15 to 20 years. If creosoted wood paving blocks were used, the floor would be good for fifty years or until actually worn out.

[Note—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the Journal.]

NEW TURBINE PUMPS OF THE ST. LOUIS WATER WORKS.

By L. A. Day, Member of The Engineers' Club of St. Louis.

[Read before the Society, October 15, 1913.]

The Chain of Rocks Pumping Station, located about seven miles north of the Merchants Bridge, is the Low Service Station for the City of St. Louis. The water is pumped from the river at this station into storage basins, where it is clarified, thence flows by gravity to three High Service Pumping Stations, where it is delivered into City mains under pressures varying from 80 to 125 pounds per square inch.

The pumping equipment at the Chain of Rocks Station originally consisted of two Worthington direct acting compound pumping engines, each having a capacity of 20 million gallons in 24 hours, and four Allis-Chalmers crank and fly wheel compound pumping engines, each having a capacity of 30 million gallons in 24 hours.

The safe working capacity of this station having been reached, it was decided to replace the 20 million gallon Worthington pumps with pumps of greater capacity.

It is only in recent years that the attention of water works engineers has been directed toward centrifugal pumps. Their low first cost, small maintenance charges, simplicity and compactness, compel instant recognition.

In considering relative values, not only first costs, but operative, maintenance and interest charges, as well, must be taken into account. Progress in the design of centrifugal pumping units has reached a point where serious doubt is created as to the wisdom of invariably installing enormous piston pumping engines, for in installing large pumping engines entailing a considerable expenditure, it seems wise to consider not only the possible life of the machinery, but its probable duration in view of present developments. It is true that the high duty steam pumping engines, with capacities for pumping large quantities of water, are superior to turbine driven centrifugal pumps in economy. However, a careful comparison between the two types of pumping units led us to choose the turbine driven type of pump.

Two 40 million gallon reciprocating pumps for this service would have cost approximately $230,000, or $115,000 each. The

duty in foot-pounds of work per thousand pounds of steam of the reciprocating type of pump would have been approximately 150 million. Two 40 million gallon turbine driven centrifugal pumps cost $55,000, or $27,500 each, with an average duty of 94 million. The average maintenance costs of reciprocating units, according to station records as kept on the Allis-Chalmers 30 million gallon pumps is $780 each per year. It is safe to assume a maintenance cost not exceeding 2 per cent of cost of turbine pumps per year, or $550 each per year. The operating charges are considered the same for each type of pump.

In capitalizing the investment the following formula was derived: $\frac{A \times W \times H \times P}{D} + F(i+d) + L + M = C$—in which

A = Total number of gallons pumped per year.
W = Weight of a gallon of water.
H = Average total head in feet pumped against.
P = Cost of steam per 1000 pounds. (13.4 cents).
D = Average duty in foot-pounds per 1000 pounds of steam.
F = Total investment.
i = Rate of interest on investment.
d = Rate of depreciation.
L = Yearly cost of operating labor.
M = Yearly cost of miscellaneous expenses of operation.
C = Total cost per year.

Solving for C with both types of pumps we obtained a difference of $13,000 per year in favor of the turbine driven pump, which means that in a little more than 4 years the centrifugal pumps will have paid for themselves. It is proposed to install a third turbine driven pump of 40 or 50 million gallon capacity in this station in the next two years, in order to bring the safe working capacity up to 150 million gallons per day, and if reciprocating pumps were necessary, it would necessitate the erection of an additional building owing to the space they require. Needle ice suspended in the river water during the winter months and sand throughout the year are additional important reasons for installing centrifugal pumps at this station, as this type of pump is admirably adapted to handle water under these conditions with practically no trouble.

In July, 1911, a contract was awarded to the Dravo-Doyle Co.

of Pittsburgh, for two De Lavel 525 H. P. Steam Turbine Driven Centrifugal Pumping Units, each to have a capacity of 42 million gallons in 24 hours, working under a total head, including friction in the suction and discharge pipes, of 46 feet; a capacity of 40 million gallons under a total head of 56 feet, and a capacity of 30 million gallons under a total head of 63 feet. The 46 and 63 feet heads are the minimum and maximum heads at this station due to the different stages of the river throughout the year.

Steam Turbine.

The De Lavel turbine is fundamentally the turbine invented by Branca, an Italian, in 1629, designed and constructed to suit the prevailing conditions, and consists essentially of a series of diverging nozzles from which the steam jets impinge upon blades fixed in the periphery of a wheel. The velocity of steam upon leaving the nozzles is very high, the speed of the wheel on these machines being approximately 10,250 R. P. M. In order to give the pumps the desired speed of approximately 610 R. P. M., the two shafts are connected by spur gears. These are of the double helical type, with the teeth cut at an angle of 45 degrees, the pitch being small in order to produce quiet running and prevent vibration. The double helical type of gear eliminates end thrust, and the small pitch of the gears brings a large number of teeth in contact at one time, which very considerably reduces the fiber stress on the teeth as well as the pressure on their surfaces. The pressure is extremely light, and does not tend to squeeze out the film of oil, so there is no tendency to abrade the metal. The gears are set in a cast iron case with a tight cover. The case is carefully machined and the bearing seats are scraped to lining bars to insure the correct distance from center to center of shafts as well as the absolute alignment of them. It might be imagined that these gears running at the speeds which they do would make an unbearable noise, but the noise is very much less than would be supposed, as the gears are cut and ground with the greatest care and accuracy.

The turbine wheel, the weight of which is 275 pounds, and diameter 31⅜ in., is mounted on a very small flexible shaft (1-9/16 in.). The flexibility of the shaft is obtained by so proportioning the diameter to the length that the shaft will stand considerable bending without straining the metal beyond its elastic limit. The shaft is rigidly supported in the two reduction gear

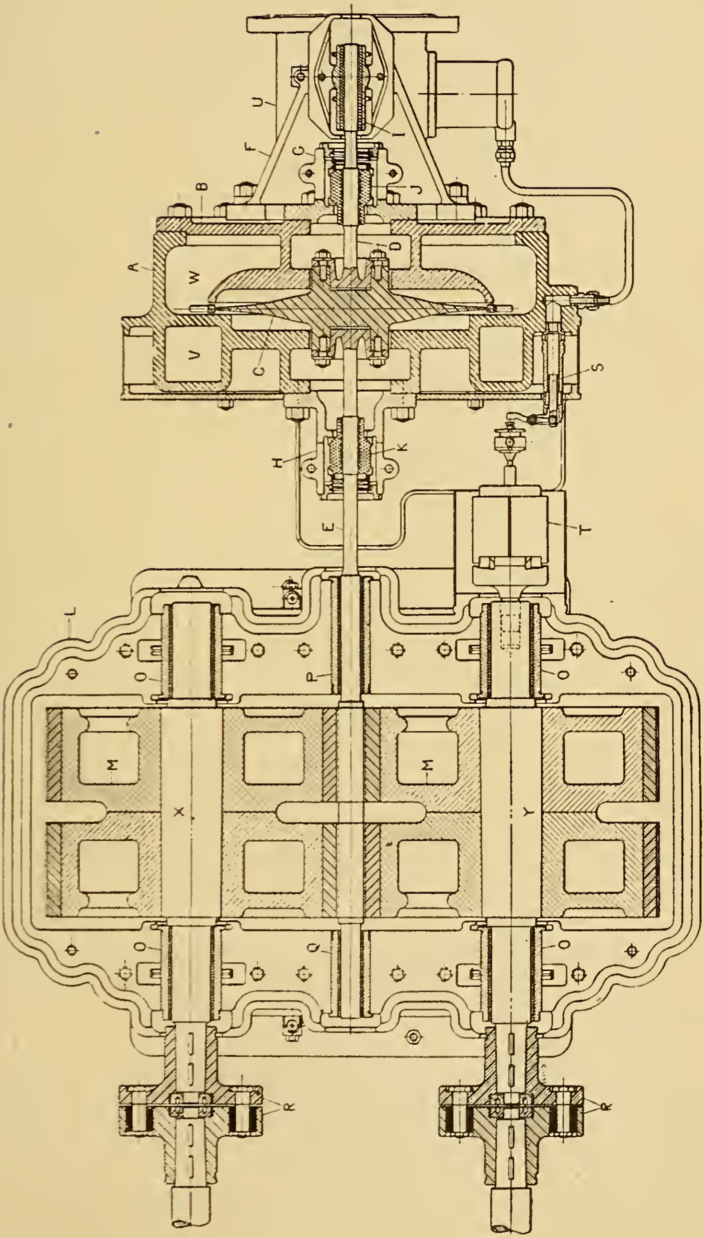

Fig. 1. Horizontal Section of Double-Geared Turbine.

pinion bearings, but is without support from the inner pinion bearing to the outboard ball-seated bearing, and on this section of shaft the turbine wheel is mounted. (Fig.1). This flexible shaft allows the turbine wheel, after it passes its critical speed, to revolve about its true center of mass, instead of about its geometrical center as it does below this speed. The critical speed is a function of the flexibility of the shaft and occurs at a point considerably below the normal speed of the turbine wheel. The construction of the wheel is such that it is practically of uniform strength to resist contrifugal force. Directly under the rim of the wheel a small groove is turned, which makes this section the weakest part in order to prevent the wheel bursting in case of any accident which would allow the wheel to run away. This safety groove protects the wheel case and all parts of the machine from damage, so that the wheel in running away and bursting at the rim can cause no greater damage than the destruction of the rim and buckets. The buckets are held in the wheel by driving them in from one side and then they are held by a bulb at the end of the shank of the bucket. The buckets are drop forgings of high carbon steel. Monel metal buckets were tried in these machines but were found entirely unsuitable for our conditions, no less than six sets of buckets having been ruined due to the cutting action of the steam. The steam at the throttle of these machines is commercially dry, but not superheated, but when it is considered that approximately 20½ per cent of steam when expanding adiabatically in a perfect nozzle from 140 pounds, absolute pressure down to a 27 in. vacuum is converted into moisture, it at once appears very evident that the selection of a proper bucket metal for a single impulse wheel is very important. The steel buckets which are now in use seem to have solved the difficulty. The probable life of a steel bucket running continuously is about two years and the cost of rebucketing the same is approximately $85.00. (Fig. 2).

The speed regulation of these turbines is accomplished by a governor valve which throttles the steam supply. The governor valve is a double disc balanced valve and is actuated by a bell crank lever from the governor shaft. The governor itself consists of two small weights which are pivoted on knife edges and held in position by a spiral spring. When the speed rises above normal these weights spread apart and push forward the gover-

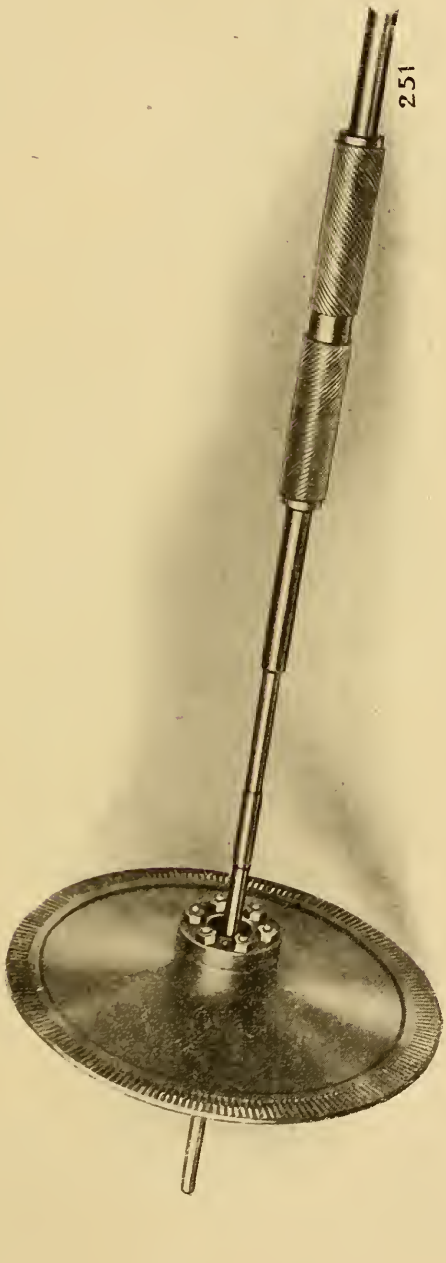

Fig. 2. Wheel Shaft and Pinion of Double-Geared Turbine.

nor pin, which acts on the bell crank lever, closing the governor valve. An automatic safety stop is also provided in case of failure or damage to the main governor valve. It consists of a butterfly valve in the exhaust pipe controlled by the governor, so that in case of accident to governor valve, the butterfly valve is automatically closed, which confines the steam in the wheel case, creates a back pressure, and checks the speed of the turbine.

Centrifugal Pumps.

Each pumping unit consists of two single stage double suction 24 in. volute pumps. The centrifugal pumps are of the simple type without diffusion vanes. The impellers are of the closed type. The water enters at the center and discharges at the periphery directly into the spiral casing which terminates in the delivery pipe. The volute or spiral case is given a variable cross section, increasing gradually toward the discharge opening, so that the lineal velocity of flow will remain constant, in spite of the increments of volume added opposite each point in the periphery of the impeller. While the double suction impeller practically eliminates end thrust a marine thrust bearing is provided at the end of the pump shaft to take care of any thrust which might occur, if for instance something should become lodged in one side of the impeller and prevent the proper filling of pump on that side. The material used for these impellers is maganese bronze and this metal has proved to be very satisfactory. However, one of the original set of impellers was cast of Government bronze and owing to the fact that a much better casting can be obtained with Government bronze than with maganese bronze, it is very likely that Government bronze will be used when the impellers require renewal. So far as wear is concerned both metals show practically no effects of the cutting action of sand after having been in service about 18 months. The impellers are finished on all surfaces, and the vanes are filed and polished by hand to templets. They are balanced for static and running balance. Figure 3 shows pump case with cover removed, also the impeller, bearings and packing. The pump case is horizontally divided through the center of the main shaft, and when the pump case cover is removed an examination of all working parts can be made without disturbing them, or any of the pipe connections. The only moving parts are the shaft and impeller, and the only

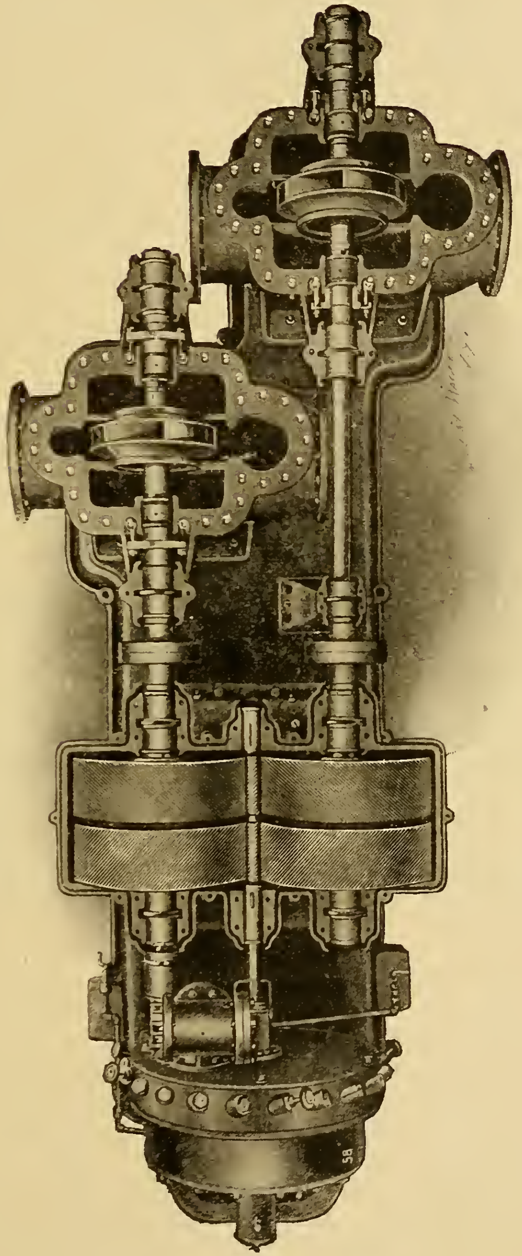

Fig. 3. Pump Case with Cover Removed.

wearing parts are the wearing rings, bearings, and shaft protecting sleeves. The pump shafts are made from hammer forged steel carefully finished. Leakage of water out of the pump or air into the pump is prevented by stuffing boxes on the shafts. The boxes contain soft packing, with a hollow skeleton ring in the middle of the packing to which clear water under pressure is admitted, forming an air tight seal and preventing a loss of suction. The shaft in the stuffing boxes is protected by a bronze sleeve which forms a bearing for the packing and can be easily removed when worn or scored, which means that the shaft proper is subject to no wear.

In order to prevent leakage from the discharge chamber back past the impeller to the suction chamber a water tight joint is provided which consists of a removable wearing ring attached to the pump case and another removable ring screwed on to the revolving impeller, the inter-meshing grooves form a labyrinth type of joint. The path of the water through the ring is tortuous and the loss of head at each turn prevents rapid flow, besides the water in the ring is set in rotation creating a counter centrifugal force opposing the leakage. The rings are made of Government bronze.

The pump shaft bearings are of the horizontally split, babbitt lined, ring oiled type. The babbitt lined bearings are not integral with the pump frame or shaft pedestal, but are formed in separate shells resting in the brackets or pedestals. The latter are separate and distinct from the pump case stuffing boxes, which prevents any possibility of water leaking past the stuffing boxes, and finding its way into the bearings and oil reservoirs.

Since it is practically impossible to maintain three or more bearings in alignment with a rapidly turning shaft, a flexible coupling is provided which divides the shaft into two parts, each part being supported by two separate bearings. The coupling consists of two separate steel flanges, one of which is furnished with a number of steel studs extending into holes in the other, the driving force being transmitted through the medium of steel lined rubber cushions.

Both of the pumping units were tested at the contractor's shops. The shop tests were conducted with the suction and discharge of each pump arranged independent of each other and the quantity of water was measured by the use of calibrated nozzles

and Pitot tubes. The first unit when pumping at the rate of 31,420 gallons per minute or 45.25 millions per 24 hours under a head of 57.19 ft. developed a duty of 111,600,000 foot-pounds. The second unit when pumping at the rate of 24,735 gallons per minute, or 37.05 millions per 24 hours, under a head of 61.45 ft., developed a duty of 101,000,000 foot-pounds. A test on our foundations was run on the first pumping unit on April 3, 1913, and the following results were obtained: Head 53.06 ft., delivery 42,900,000 (29,800), Duty 96,800,000. On April 4, 1913,

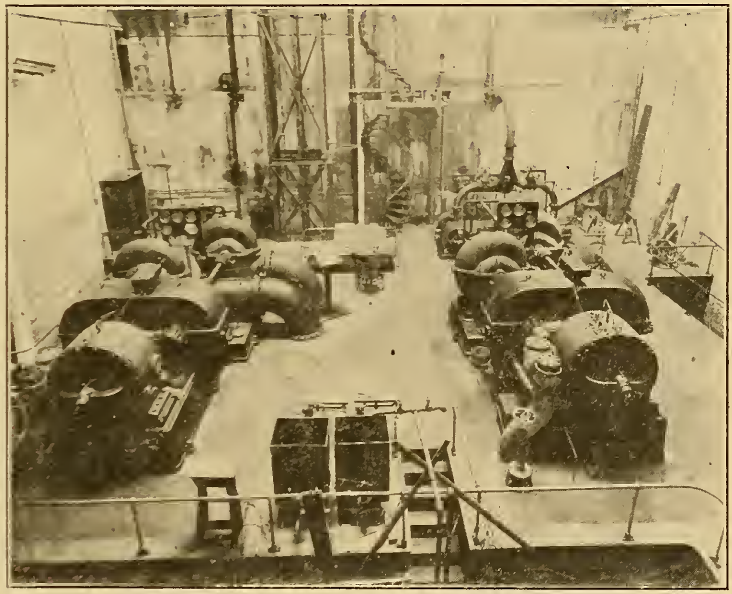

Fig. 4. New Turbine Pumps at St. Louis Water Works.

the following results were obtained: Head 55.46 ft., Delivery 39,040,000 (27,100), Duty 93,800,000. The delivery was measured by a Venturi meter which had been standardized by basin measurement. The original impellers, i. e., the impellers that were in the pumps when tested in the contractor's shop, were designed to work with a suction lift of 10 to 12 ft., and were designed to show maximum efficiency under this suction condition. The pumps, however, when placed on our foundations operated under a minimum suction head of two feet. This necessitated a change in the design of impeller, which consisted in

slightly changing the vane angles and reducing the number of vanes to six instead of eight, also increasing the diameter of the impellers slightly. After changing impellers a test was run on July 21st, 1913, and the following results were obtained: Head 58.86 ft., Delivery 38,480,000 (26,720), Duty 104,100,000. The head was then changed to 62.15 ft., resulting in a delivery of 36,-458,333 (25,300), and a duty of 101,600,000. Figure 4 shows the new turbine pumps as installed.

DISCUSSION.

Mr. S. Bent Russell. I would like to ask Mr. Day the method of testing the speed of that centrifugal pump in making a duty test. I will be glad to find out what is the best speed.

Mr. L. A. Day. How do we determine the best speed at which the pumps should run? That is a matter of calculation to a great extent and each pump, I would imagine, would have its own particular characteristics, as far as the exact speed is concerned. For instance, the design of the wearing ring would affect the capacity of the pump, and, as I say, the builders themselves have constants which they use and which we do not know about.

Mr. S. Bent Russell. Any difficulty in holding the right speed?

Mr. L. A. Day. Absolutely no difficulty. The turbine is on a governor all the time.

Prof. E. L. Ohle. You do not change the speed then, with the change of head?

Mr. L. A. Day. No.

Prof. E. L. Ohle. Just keep a constant setting so there would be a condition when you would get the maximum duty.

Mr. L. A. Day. You could design a pump and run it at variable speeds and maintain the same delivery at all times, but we thought that was a complicated design and not desirable.

Prof. E. L. Ohle. You felt it was not necessary in your case at all?

Mr. L. A. Day. We did not care for that style of pump.

Mr. John Hunter. I would like to ask what vacuum you are able to maintain, and the efficiency of the pump and turbine.

Mr. L. A. Day. The mechanical efficiency will run around 95 per cent over all. The efficiency of the gears themselves, 98½ per cent. The vacuum is 27 to 28 inches. We use a dry vacuum

pump and the condenser is right in the discharge pipes of the pumps. We do not get as high a vacuum as you get.

MR. E. H. TENNY. I would like to ask Mr. Day what the steam consumption of that turbine unit is.

MR. L. A. DAY. At full load the steam consumption was 15.1 pounds at half load 16.3; at three-quarters load 16.1.

MR. E. E. WALL. I might say that these pumps were investigated by Mr. Day. He did practically all the work himself in looking into the matter and made the recommendations. I simply followed his advice in the whole matter.

PROF. E. L. OHLE. I think there is one thing that all mechanical engineers object to, and that is stating the duty per thousand pounds of steam, which really does not mean anything. It should be per million B. t. u. Then you have the correct relation between the duties of different pumps. In one case you might have 200 degrees of superheat and in another case saturated steam with an entirely different amount of available heat.

MR. L. A. DAY. Yes, that should be corrected.

MR. L. A. DAY. I might add that the steel in those wheels cannot be made in this country. It is made in Norway. It seems our steel makers are not sufficiently posted to make as homogeneous steel as it should be.

MR. JOHN HUNTER. How much clearance have you between the wheel and the wheel case?

MR. L. A. DAY. About 3-16 of an inch. The clearance is of little importance.

MR. JOHN HUNTER. Have you ever measured for condensation of steam within the turbine, and is it high?

MR. L. A. DAY. You mean the condensation; in other words the steam consumption of the turbine?

MR. JOHN HUNTER. No, the condensation in the wheel case.

MR. L. A. DAY. If I remember correctly that amount to about 1½ per cent of the total steam used.

MR. JOHN HUNTER. What ratio of square feet of heating surface have you in that condenser?

MR. L. A. DAY. I do not remember the figure exactly. I think it is something around 2½. The condenser gets all the water pumped by the pumps. Almost any size condenser could be used.

PROF. E. L. OHLE. I wonder if they figured on a low pressure turbine for exhaust steam here.

Mr. L. A. Day. Yes, we figured on a low pressure turbine, but we did not have any low pressure.

Prof. E. L. Ohle. You are running condensing, of course, but I wondered if you had figured on them.

Mr. L. A. Day. We could have run those reciprocating engines on a vacuum of say 5 pounds and taken the steam in under a vacuum of 5 pounds and expanded it down to a 28 or 29 inch vacuum, but when the matter was taken up with the turbine builders they were all afraid of it, due to the excessive moisture in the exhaust steam.

Prof. E. L. Ohle. Of course the reciprocating engine works at a higher efficiency on the high pressure end and a turbine on the low pressure end of the cycle.

Mr. L. A. Day. That is an ideal condition. We could not very well obtain that condition up there.

Mr. John Hunter. Four of five years ago the low pressure turbine was considered much more favorably than it is to-day for power station work.

Prof. E. L. Ohle. Because they are putting in so much larger units, for one reason.

Mr. John Hunter. The low pressure turbine is considered more economical than the high.

Prof. E. L. Ohle. Some figures came out this year to show that you could put in a low pressure turbine and reciprocating engine at a saving over a high pressure turbine.

Mr. John Hunter. Over the initial cost?

Prof. E. L. Ohle. Yes, over the initial cost. You actually could do that.

Mr. John Hunter. I do not see how that could be possible, because you can buy a turbine for a very much lower figure than you can buy an engine. You can buy it for something like $14, a K. W.; whereas a combined engine and generator will run to $40.

Prof. E. L. Ohle. That is quite true. I was not vouching for these figures, I just said the figures came out very recently; they were based on the great increase in efficiency and the much lower steam consumption of the combined units. They figured that the saving of steam would be sufficient to make up the increased interest on the investment.

[Note—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the Journal.]

ENGINEERING AND ACCOUNTING.

DISCUSSION BY LESLIE H. ALLEN, MEMBER OF THE BOSTON SOCIETY OF CIVIL ENGINEERS AND THE AMERICAN SOCIETY OF ENGINEERING CONTRACTORS.

[Volume 52, Page 153, March, 1914.]

A proper understanding between the engineer, the contractor and the accountant is the prime need of a proper system of accounting on construction work, as Mr. Scholefield insists early in his paper. It is, however, an unfortunate fact that such an understanding is very often lacking and consequent friction and trouble and inaccurate results are obtained. Generally, this is because each man wants to divide his costs in an entirely different way. This is because the records are wanted for entirely different purposes. The accountant on construction work usually wants to get at completed costs of buildings so that he may make proper provisions for depreciation, maintenance and insurance. The engineer or contractor, on the other hand, simply wants to know the unit cost of the work which he is doing and he is not interested in the cost of such items as excavation in one building as distinct from similar excavation in an adjoining building of a group.

A simple method of finding costs of buildings for the accountant, without interfering with the engineer's or contractor's distribution, I have found to be as follows: To keep the unit cost of work done by the contractor according to engineering methods and to secure from him a schedule of quantities of materials and work done in each of the buildings or structures, which is being executed, and then at the close of the job to combine these units at the unit prices which have been determined by the cost accounting, so as to get the cost of the building. For instance, if three buildings, A, B, and C, were built in one group the cost of all excavation would be kept as one item, the cost of all concrete foundation work would be kept as another item, the cost of all carpenter work would be kept as another item. These would, of course, be subdivided according to their

nature, if necessary. The contractor's cost distribution would show, for example:

30,000 yds. of excavation @ .50	$15,000
12,000 yds. of concrete @ 8.00	96,000
50,000 cu. ft. of brickwork @ .50	25,000
200 M. bd. ft. of hard pine roof and floor timbers and framing @ 50.00	10,000

and so on. The engineer's schedule of quantities would show that these quantities were divided among the different buildings in the following proportions, and the cost of buildings would be determined as under:

BUILDING A.

Excavation, 12,000 yds. @ .50	$ 6,000
Concrete, 6,000 yds. @ 8.00	48,000
Brickwork, 5,000 cu. ft. .50	2,500
Hard pine, 80 M. @ 50.00	4,000
	$60,000

BUILDING B.

Excavation, 7,000 yds. @ .50	$ 3,500
Concrete, 2,500 cu. yds. @ 8.00	20,000
Brickwork, 20,000 cu. ft. @ .50	10,000
Hard pine, 71 M. @ 50.00	3,550
	$37,050

BUILDING C.

Excavation, 11,000 yds. @ .50	$ 5,500
Concrete, 3,500 cu. yds. @ 8.00	28,000
Brickwork, 25,000 cu. ft. @ .50	12,000
Hard pine, 49 M. @ 50.00	2,450
	$48,450

It can be seen, therefore, that the cost of each building can be worked up in this manner in a very simple manner and give much more accurate results than any attempt to separate the time, because the accountant is facing the trouble, when the time is separated, of then getting his material and contributive expense separated, and this he will have no data to work from, as

it will not be accurate to proportion the cost of cement, stone, teams, etc., according to the amounts of the payrolls on different buildings. The only way is to apportion them according to the units of material actually in place on each building, and this can only be obtained by measurement.

Mr. Scholefield is absolutely right in insisting that freight is part of the material expense. This is so in any section of the country. But for administrative purposes, I find that it is advisable to distinguish between railroad freight and teaming by contract, and any teaming, including handling, which is under the supervision and control of the superintendent of construction on the job. If a contract is let with a firm of truckmen or teamsters for the hauling of steel or cement, this is in the nature of freight and is treated by me as such. But if teams are purchased by the owner or by the contractor or hired by the day they should be reckoned as part of his labor force for the purpose of cost accounting, as the aim of cost accounting on labor for the contractor's purposes is to determine the efficiency of the work done and of the superintendence of the work.

It is, of course, understood that all freight is charged to the particular material to which it applies, and the cost of freight is not one lump sum item distributed over the whole cost of construction work.

I have not found it necessary or desirable to keep stores accounts on construction work, with the exception of tools and commissary accounts. It is usually possible to determine before hand with fairly close accuracy, the quantities of material required for each part of the work, and the distribution of these can be thus obtained without any trouble or the needless complications of keeping stores accounts. Waste of material is very small on construction work and is practically a negligible factor. I find, however, that it is desirable to have a tool house with a tool keeper in charge and to keep a proper record of tools that are issued and returned. I do not attempt to distribute costs of tools on the daily units of work done, but reserve the distribution until the end of the job.

I think no contractor will agree with Mr. Scholefield's recommendation for individual daily time slips. It is true that the usual time book is, as he says, "a delusion and a snare," and leaves the way open for a man to neglect the conscientious dis-

charge of his duties. But the daily time slip is worse. Many of the workmen are illiterate and are with us for so short a time that it is not feasible to properly instruct them in the duties of keeping a time slip. Furthermore, they have no place to put them and would have to carry them around in their pockets during the course of a day in which they may get hot or very wet. The state of the time slip at the end of the day would be better imagined than described. It is also impracticable to ask the foreman to keep these men's time in time books. In the first place, the foreman ought to be busy doing the work that he is engaged for, and not doing clerical work. If you pay a man $30.00 to $50.00 per week for overseeing construction work, you

FORM NO. 61

Job No. ABERTHAW CONSTRUCTION COMPANY, Boston Date ....

At TIMEKEEPER'S FIELD SHEET Timekeeper's Name .... Sheet No. ....

Man's Number	In a.m.	In p.m.	Out	7 a.m. to 8	— 9	— 10	— 11	— 12	— 1 p.m.	— 2	— 3	— 4	— 5	— 6	Overtime	Total Hours

want him to earn it, and not waste his time doing work which could be done equally well by a time clerk at ten to fifteen dollars, who would, moreover, be better fitted to do the clerical work by reason of his having had a different training. We have never found that our foremen have been able to do clerical work well, and, moreover, they are very disinclined to take any trouble to do it correctly. This is the general experience of all contractors. It is therefore necessary to employ a timekeeper who will give on a job of any size, his whole time to keeping the payrolls and recording the distribution of time worked by the men.

It is usual to make up a code, nemonic or numerical, to define the ways the time should be distributed, and after checking the men in the morning it should be the duty of the timekeeper to make at least four rounds per day, checking the men and entering in his book the classification of the work they are doing.

Among most contracting firms, this is the weakest part of the system of distribution, as the timekeeper will walk around, making rough notes on pieces of scrap paper, intelligible only to himself, and enters them up perhaps two or three days afterwards, on the time distribution sheets. I have therefore introduced in my own work a proper printed form for the timekeeper's use shown in the accompanying illustration. This is not in a book, but is in loose sheets carried in a stiff binder similar to that used by the express companies' teamsters. This has columns for each hour of the day and lines for each man at work, and the timekeeper as he makes his rounds enters against each man's number in the hourly spaces the code word or symbol for the work he is doing. Usually men are kept for at least two or three hours, if not all day, on one class of work, but it is necessary to make at least four rounds to pick up the changes made by the gangs from one item to another. For instance, if three carloads of coal came in, they would have to be unloaded quickly to save demurrage, and a gang that might be working on excavation would have to be shifted over to turn onto this unloading. In the same way, a gang that might be working on carrying brick up to noon, at noontime the blasting of the holes drilled in rockwood for rock excavation would be fired, and these men would be put onto clearing up the rock debris and either taking it to the crushing plant or disposing of it. We do not, however, find it necessary to have the time keeper go round every hour, as when he finds that a gang has changed from the work they were on since the last time he went round he can ask the foreman in charge at what time the change in the gang was made, and so get his distributions correctly. As far as I know, this field sheet is not used by any company except the one that I am connected with, and it is considered a very great advance in methods of securing the distribution of time work.

The blind check on material received is very desirable, but very seldom made by contractors on construction work.

I believe that on construction work it is not desirable to enter up defective materials received and then bill them out as returned. In my own practice, they do not appear on the cost accounts at all, although theoretically this is not defensible, yet in practice it is found to be the best way.

There is, as a rule, very little material remaining on comple-

tion of the construction, but no mention is made by Mr. Scholefield of plant and tools remaining on hand at the completion of construction. Very frequently these are taken over by the contractor at a second hand price, or if not, it is usual to sell them either by auction or through dealers who make a business of dealing in such equipment. If, however, they are left on the job for future use, their depreciation must be estimated, and it must be borne in mind that the depreciation of plant on construction work is very much more rapid than depreciation of equipment in a factory. Owing to the fact that they are used out in the open, they are subjected to very rough usage and often improperly set up, improperly housed, and not properly cared for, their life is very short indeed. In very few cases can the life of an item of construction plant be reckoned as more than two or three years. This would be increased if plant were properly looked after on the particular job on which the accounts are kept, and properly repaired and overhauled from time to time. This is seldom done on construction work, and it is best for the accountant to be on the safe side and allow very liberally for depreciation. Tools are generally worthless by the time the job is completed, and it is not safe to make any allowances at all for the value of such items as picks, shovels, hose, pulleys and the like.

The distribution of overhead expense is a problem in itself, and as Mr. Scholefield says, cannot be done intelligently without the advice of the engineer. The overhead expense of supervision should be, in my judgment, pro-rated over the payrolls, either by a percentage of cost or by the number of man-hours. The former method is a little simpler and is probably almost as accurate as the man-hour method. On material, all freight and all unloading, hauling and storing should be charged to the items of material to which they belong, and the distribution of material costs made in proportion to the units of work incorporated in the structure. I do not consider that it is correct to distribute any costs of planning and supervision over material expense.

I am not able to follow Mr. Scholefield in the latter part of his paper, which deals with depreciation, maintenance, valuation, as my work as cost accountant lies solely with a construction company, but I think that the subject of cost accounting on construction work is one which is assuming increasing im-

portance in these days. It is one to which very few contractors have given proper attention, and one which needs very careful study, and the thanks of all are due to Mr. Scholefield for the very careful and thoughtful manner in which he has presented his ideas on the subject.

Mr. J. B. Scholefield. Mr. Allen has written a very interesting discussion from the point of view of the contractor, and there is little need for reply or criticism.

I feel that his method of arriving at the cost of buildings can only be used when the structures in question are alike in every detail. To apply a unit cost in order to find the cost is surely putting the cart before the horse unless identical conditions exist.

His point as regards hauling may be well taken for a contractor's purpose in obtaining daily costs, though even there such costs can be obtained without treating local hauling as labor. For engineer's costs on which to base further estimates such hauling should be shown as a transportation cost. Direct labor applied on material need not vary greatly in different localities and estimates can be made by judging past costs to agree with increased or decreased rates; but every different locality provides different conditions of roads, distance, or facilities. These differences, with consequent variations in mode of transportation affect the actual cost of the material as they affect the selling price in different sections of the country.

In general, I agree with Mr. Allen's remarks on "Stores and Tools."

His views regarding daily time slips must be admitted if the time is kept by gangs. Where, however, the timekeeper records each man, these daily time slips can well be used. In any case it is advisable to check the timekeeper's results by the foreman's daily report of work done in which he summarizes the activities of the men. There is not a great difference between the daily time slip and the printed form which Mr. Allen describes

I agree with Mr. Allen's remarks on tools and machinery remaining at close of construction. Loose tools have practically no residual value and the most satisfactory method is to revalue

large pieces of machinery. This should be done by some person not especially interested in the ultimate cost of the job.

I disagree with Mr. Allen in his remarks on the distribution of overhead expense. This cannot be properly apportioned according to labor cost. The highest paid men in the organization might spend weeks over a piece of machinery which took but a few days of common labor to instal. For example, the grading for a power-house would bear as much overhead expense as the account for intricate machinery. Why should the purchasing department's expense be charged out on the labor basis?

Mr. Allen's closing words are, I fear, more gracious than correct. My paper barely scratches the ground and his discussion is very welcome.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

ASSOCIATION OF ENGINEERING SOCIETIES
REPORT OF AUDITING COMMITTEE.

Boston, Mass., April 15, 1914.

Prof. Gardner S. Williams, Chairman,
Board of Managers, Association of Engineering Socs.,
Ann Arbor, Mich.

Dear Mr. Chairman:

Pursuant to your request of March 16, we have made an effort to verify the accounts of the Secretary of the Association of Engineering Societies for the year 1913 and transmit, herewith, in triplicate, a statement of receipts and expenditures for 1913 and balance sheet as of January 1, 1914.

We think these statements will be reconciliable with the report of the auditors to which you refer.

We have not attempted to verify the receipts from the several engineering societies. This can only be done by comparison of the receipts with the mailing lists. With the exception of a few very small items, the principal payments have been verified with the original vouchers.

As noted upon the balance sheet, a cash payment of $1,250 was made by Mr. Brooks to J. W. Peters, Secretary. There now remains in Boston funds to the amount of $554.23. The sum of $900 is due Mr. Brooks for back salary in 1913, leaving a balance due Mr. Brooks at the present time of $345.77. This last item is subject to some small payments which Mr. Brooks may have made and possibly some small bills which may not yet have been rendered, on account of packing and shipping supplies to Mr. Peters, but may be assumed to be substantially correct as of this date.

The discrepancy between the statement filed by Mr. Brooks and the one sent you, herewith, appears to be due to the adjustment of the postage account and to certain small cash receipts amounting to about $20 entered on the books but not shown on the bank statement.

Very truly yours,

Harrison P. Eddy,
Edwin R. Olin.

RECEIPTS AND EXPENDITURES, 1913.

Receipts.

Cash on hand and in bank Jan. 1, 1913	$ 5,368.56
Balance deposited with postmaster	10.01
Engineers' Club of St. Louis	884.26
Boston Society of Civil Engineers	2,083.31
Civil Engineers' Society of St. Paul	170.05
Montana Society of Engineers	300.62
Technical Society of the Pacific Coast	226.12
Detroit Engineering Society	684.09
Louisiana Engineering Society	440.22
Utah Society of Engineers	290.81
Oregon Society of Engineers	306.68
Subscriptions	428.78
Advertisements	100.02
Sales of Journal	126.19
Sales of Reprints	1.35
Sales of Sundries	14.08
Interest on Deposits	53.03
	$11,488.18

Expenditures.

Printers' bills	$ 4,100.00
Illustrations	310.40
Postage	133.91
Secretary's salary, Nov. 1, 1907, to Jan. 1, 1913	4,650.00
Stationery	.85
Telegrams	9.11
Express charges	4.74
Collection charges	8.92
Traveling expenses, J. W. Peters, 1913	33.05
J. W. Peters, Secretary, to open St. Louis account	1,250.00
	$10,500.98
*Cash on hand, Jan. 1, 1914	987.20
	$11,488.18

*$900.00 of this amount is due Mr. Fred Brooks for salary for the year 1913.

BALANCE SHEET, JAN. 1, 1914.

Assets.

Cash in Boston*		$ 987.20
Due from Societies—		
Boston	$ 17.65	
St. Paul	1.10	
Pacific Coast	49.10	
Detroit	6.45	
Louisiana	217.37	
Utah	.56	
		292.23
Due from advertisers		25.14
Due from purchasers of Journal		34.61
Sundries		1.50
		$1,360.68

Liabilities.

Printer	$ 426.54
Illustrator	6.43
Salary of Secretary, 1913	900.00
Due account subscriptions	20.58
Surplus, per Boston account	7.13
	$1,360.68

*Cash $1,250.00 paid to J. W. Peters, Secretary, not included in this account.

Editors reprinting articles from this JOURNAL are requested to credit the author, the JOURNAL OF THE ASSOCIATION, and the Society before which such articles were read.

ASSOCIATION ENGINEERING SOCIETIES

ORGANIZED 1881.

Vol. 52. JUNE, 1914. No. 6

ECONOMICAL DESIGN OF FACTORY BUILDINGS.

BY W. E. KING,* C. E.,
MEMBER OF THE CIVIL ENGINEERS' SOCIETY OF ST, PAUL.

[Read before the Society October 13, 1913.]

The economical design of factories involves the solution of a large number of simple engineering problems. It is the intention of this paper to discuss these problems in their relation to each other in order to give a general view of the economics of this form of construction.

Factory design requires a broader knowledge of engineering than for most types of buildings. For this reason it is the work of an industrial engineer rather than an architect.

The industrial engineer should be an engineer with a fair working knowledge of architecture, civil, structural, mechanical and electrical engineering. It is essential to the economical design of any building which is to house machinery and human beings doing work which involves repetition of the same act, that the designer of that building should have a very clear working knowledge of all the machinery installed and the processes which are to be carried on in the finished structure.

In organizations which do a considerable industrial engineering business it is customary to maintain engineers familiar with the various manufacturing processes. Such an organization usually maintains mechanical, electrical, civil engineering and architectural departments.

*Secretary, Toltz Engineering Co., St. Paul.

A purely engineering organization will tend to minimize the importance of the architectural requirements of the work devoting its time to the considerations of economy of construction and efficiency of operation. Both phases of the question should be considered in the design of any building but certainly the esthetic considerations in the design of a factory are not as important as the parts of which the study must necessarily be made by an engineer.

Whatever may be the title by which the designer of such a building be called, it is at least fair to state that all parts of the structure should actually be designed in his office and such work be paid for by him as a part of the service for which his clients pay him. The practice, of some persons in the business, of forcing the contractor for structural steel or reinforced concrete, or other parts of the building, to prepare the designs is certainly unfair to the client. There are other disadvantages in allowing the contractor to do the engineering.

Location.

The work of the industrial engineer should commence, if possible, before the location of the factory is determined upon. The first consideration is, of course, the proper locality for the industry. This is largely an economic problem which the engineer may or may not be required to study.

The cost of any manufactured commodity to the retailer consists of the following items: Cost of raw materials, cost of the transportation of these raw materials to the factory, cost of labor on materials, cost of power, overhead charges, including interest on money invested, depreciation of plant, insurance, office time and advertising, cost of distribution, profit to the manufacturer.

Assuming the price to be received for any finished commodity to be fixed by competition, then that project which will pay the largest profits, is, of course, the one where the sum of the first six charges is a minimum. This does not necessarily mean that any one item should be reduced to a minimum but that the sum of all the items taken together is the least possible. The usual difficulty is that some one man almost always plans each project with the idea of reducing some one item to a minimum. For instance a man who has spent the larger part of his time in handling of workmen will insist that the plant be so located that

there will be an abundance of cheap labor. If he had at one time been a purchasing agent he would plan his plant to save all freight possible on raw materials. The sales manager is interested in the location of the factory with respect to the market. The man who furnishes the money is sometimes unduly interested in cutting the first cost down to a minimum, without regard to whether the interest on his money might be larger if more money were invested.

It should be the duty of the engineer to study these questions and to so present them that they will occupy their proper rank of importance. This rank is, of course, different in different kinds of factories. In the fabrication of structural steel, for instance, perhaps the most important factor is freight. This includes freight from the rolling mill to the factory and freight on the finished product from the factory to the consumer. In some parts of the United States this freight amounts to more than half the cost of the finished product. However, in the manufacture of candy, for instance, the freight is of small importance and the proximity to the market and the cost of labor is of greater importance.

Charts May Be Used.

Where freight is one of the chief considerations, charts may be prepared showing the zone in which a product may be profitably marketed. The boundary of each zone will be determined by considering the sum of the freights on raw and finished materials for the proposed location as compared with other possible locations. The properly prepared chart will show the overlapping territories where competing factories sell on an equal basis. It will show the area where the factory in question has the advantage and it will also indicate the areas which cannot profitably be reached.

The matter of available market probably reaches its greatest importance when the capacity of a profitable factory is about to be increased. It may be that the selling organization is now reaching all of the profitable market zone and that to increase the sales the product must be marketed at a disadvantage.

Some industries use large amounts of fuel or power which requirement is the determining factor in their location. Many of our rolling mills are located at Pittsburgh because of available coal supply. The cheap water power at St. Anthony Falls

partly determined the location of our flour milling industry. This tendency to group factories around water power sites will probably not be as marked in the future because our modern methods of electrical transmission allow power to be economically delivered at a considerable distance.

Having determined on the vicinity where the factory is to be built, the next consideration is the purchase of the exact site necessary for the project. The exact area of land which is necessary is usually a troublesome one. Most successful projects are hampered by lack of room to provide for their growing needs. On the other hand, it is a serious handicap to a young industry, to be burdened with heavy interest charges and taxes on land not at the time in use.

The size and shape of the area necessary for present needs is usually determined by making a preliminary plan of the whole project. If the engineer be unfamiliar with the need of the industry in question, this will usually involve quite an extended study of the methods of manufacture used by the particular organization and of similar organizations in other places. If, however, the designer has already prepared plans for other similar plants the tentative preliminary plans involve only a study of the peculiar requirements of the special case. This preliminary plan should, of course, take in the reasonable growth of the industry, which usually may be approximately obtained by a comparison with similar industries in other communities. With the approximate area required clearly in mind, a search of the locality will usually show a number of available sites. For projects of some importance, plats are usually prepared showing how the proposed sites may be developed. These plats should show the approximate grades and elevations of all adjacent streets, the location of sewer, gas, water and power connections and the available connection to adjacent railroads or sidetracks. If grading of streets or of the lots will be necessary, this should be estimated and added to the comparative price of the lots. For the purposes of comparison the cost of the sidetrack, including necessary grading, the cost of sewer, water, gas and power connections should be obtained. Very often the owners will buy a lot first, without considering the cost of these things, which must be added to make the lot available, and in so doing they fail to get the most economical site. Plats showing the proposed sidetrack should be submitted to the railways interested and assurance

should be had from their engineering and contracting departments that they are willing to put in the desired connection. If the side track must cross the public road it is just as well to be sure of the permit before putting money into the lot.

Sidetracks.

At this time a study should be made to determine the number and length of sidetracks which will be required. In general the track should be long enough to hold as many forty-foot cars as the company will need to load and unload in any one day. In isolated places, where the cars are not set as often as that, the side track must be long enough to allow for all the unloading and loading which must be done between each setting by the switch engine. Sidetracks for loading and unloading should in general be level. The rules of the railroad in question, of the state and interstate railway commissions and the state labor laws are the determining factors in the amount of room required for sidetracks.

Building Plans.

After the exact location of the site is determined then the plans of the buildings may be prepared. It is, of course, a mistake to make the final plans of any building before its definite location is settled. The natural grades of the land itself, the streets, the points of the compass and the condition of the subsoil almost invariably change the plans to such an extent that they must be revised or redrawn. All of these conditions should be determined by an exact survey before work on the plans commences.

As before stated the basis for the design of the factory building should be a complete understanding of the processes to be carried on in the building. Too many factories are built first and the machinery just put in, one piece at a time, after the building is completed. This usually results in the uneconomical use of the floor space, unused spaces occur in some parts and a conjested condition results in other parts.

The first plans to be prepared should be complete machinery plans. A study should be made of the progress of the materials through the shop. In general the manufacturing processes should be so arranged that there will be no lost motion. The various materials which go to make the finished product should all travel through the various parts of the factory in such a way that they

will arrive at the assembling room without having traveled any greater distance and without having been transferred more times than is absolutely necessary. Leaving the assembling room, the materials should go by the shortest possible route to the storage and shipping rooms. This part of the work is of course, best planned with the prospective superintendent of the shop. It is sometime difficult to get the benefit of this man's detailed knowledge and experience without letting his narrowness of viewpoint blind the designer to the broader phase of the question.

As a rule a good factory superintendent has spent the larger part of his life in some one factory. He probably has made that factory a success. That leads him to think that he knows all there is to know about that business. At least he thinks he knows more than any engineer whom the owners can hire. That is generally true but his difficulty is that he is so close to his job that his perspective is warped. For instance, if ten years ago he tried a belt conveyor in his factory which he bought and installed improperly himself, and then afterward abandoned because it did not do the work required, he is convinced that he does not want a belt conveyor in his new factory. The fact that belt conveyors have been improved since he tried them and that there are thousands of them working satisfactorily under similar conditions will impress him only if you can overcome his prejudices. If you can make him feel that he and the engineer are working together to get the best possible design and that you realize the value of his suggestions, then, generally, it is possible to get him to listen to yours.

An instance of how an engineer may save an owner money came to the writer several years ago. A client came stating that he wanted a foundry building with 35-foot clear head room. This is an unusual height and we questioned its advisability. He stated with very great decision, that his superintendent wanted it and that he was going to get what he wanted. A study of the exact conditions, comparing them with similar work being done at other shops, showed that they actually needed an area of forty feet by forty feet with a clear height of about thirty feet, which was used for assembling certain castings. It was also found that this area was only needed for an average of one day per month and finally that this work could be better done in a large shop adjoining, which was high enough. This study resulted in the reduction of the clear height of the building from

thirty-five feet to twenty-two feet, for a full length of 250 feet. This is not an unusual instance. Many factories are built with mistakes more extravagant than this one would have been. Mistakes in design which involve a continuous loss of time and labor in the manufacturing processes are more serious because they involve a continuous loss to the business.

It is a common thing to have one of these so-called "practical men" tell you "You build me a building so big and I will put the machinery in myself, without any plans." Even with a man competent to do this, there is considerable advantage in arranging the machinery on paper first. It is easier to see where the waste spaces in the room occur and to correct it on paper than it is with the life-sized models. Then, too, these machines usually have foundations, shafts, electric wiring, and these things have a tendency to interfere with each other and to require the cutting of hideous holes in the completed building.

The building should be built to suit the machinery. The columns and beams, the height of stories, the location of heating and plumbing pipes, the sprinkler system, the natural and artificial lighting should all be arranged to suit the machinery.

The economical arrangement of the structural parts of the building should also be taken into consideration in the arrangement of the machinery. If possible the columns should not be spaced to suit special machines unless there is some very decided advantage in doing so. It must be remembered that the life of a building is several times the life of the machinery installed and that the machinery of the future may be entirely different.

Types of Factory Buildings.

There are two types of factory buildings which are here considered separately. The first is the ordinary one-story building with a hip roof which may or may not be surmounted by a monitor. It usually has large unobstructed floor space to provide for the movement of cranes and other large machinery. The second type is the warehouse type of one or more stories in height. Industries which require a clear floor space of more than twenty-five feet in either direction are usually housed in one-story buildings because it is expensive to carry the weight of upper floors on long spans. Where the materials manufactured are of such size that columns spaced from sixteen feet to twenty-five feet on centers are not objectionable the building of several stories is usually more economical.

A one-story building costs the most per square foot of floor area. This cost per square foot of floor area decreases somewhat with the number of floors built, up to four stories. Above that height the cost per square foot gradually increases. There is comparatively little difference in the cost per square foot of floor area between a three and an eight-story building.

If basement floor space is suitable it is the cheapest which can be obtained, except where the loads to be carried on the first floor are extremely heavy. A one-story shop building in fireproof construction, will cost from $1.25 to $2.00 per square foot of floor space area, depending upon the height of the story, depth of footings, length of spans and kind of exterior finish used. Fireproof buildings of more than one story may be built for as little as fifty cents per square foot of floor area. These approximate figures do not contemplate any sort of plaster or interior finish except whitewash. They do include a properly finished cement floor. The cost per square foot of course decreases as the size of the ground plan increases. It is more for a long, narrow building than for a square building. However, a factory building should not be made too wide on account of the difficulty in properly lighting the interior. For ordinary factory work from forty feet to fifty feet is the best width. A building of this width can be lighted with a story height of from twelve to fourteen feet. If the width of the building be made from seventy-five feet to one hundred feet then the story height should be increased to from fourteen feet to sixteen feet, the windows being placed as high as possible.

One-story shop buildings are usually built of what may be termed semi-fireproof construction. They are usually built of materials which will not burn but cannot be said to be entirely fireproof because the steel trusses are usually left unprotected so that they might be damaged in case of fire occurring in the contents of the building. As before stated the one-story plan is usually adopted where large, unobstructed floor spaces are required. This results in long span steel trusses supporting the roof.

The most common type of roof is the "A" shaped roof. This roof has many advantages. It is easy to keep water tight, it clears itself of snow easily and with monitors or ventilators at the peak provides good ventilation for the factory. If these monitors are made wide enough and are provided with windows

they admit considerable light, but if the building is high and wide, monitor windows usually do not admit a satisfactory light.

A better type of roof, where light is essential, is the sawtooth roof. This roof is made up of a series of pitched roofs, rising towards the north and stepping down with a vertical step, in which windows are installed. These windows, facing towards the north, admit a diffused light which illuminates the floor below without casting shadows. If the windows in the sawtooth construction are arranged to swing, they provide as good ventilation as the old monitor type. The disadvantage with sawtooth construction is that it presents a number of valleys where snow may lodge. In some cases steam pipes have been installed to melt the snow. This serves the purpose but is rather expensive. In buildings where there is considerable steam in the air condensation gutters are necessary under monitor and sawtooth windows.

The Roof.

The most unsatisfactory problem in shop building is probably the roof. It first must be water tight; second, if the building is to be heated in winter it must be of such material that condensation will not occur on the under side; third, it should be fireproof; fourth, it must compete with a large number of cheap roofs which are lacking in one or all of these qualifications. A standard roof construction consists of three-inch hollow book tile, laid on steel tees. This tile is covered with some good prepared roofing which is cemented and tacked to the tile. This roof is very expensive but it fulfills all the requirements stated above. It costs, including supports, about thirty cents per square foot.

Another good roof is two-inch dressed and matched sheathing, laid on wood or steel purlins and covered with a good prepared roofing. It is just as good and much cheaper than a book tile roof, but, of course, is not fireproof. It will cost about twenty cents per square foot, including supports.

In some instances a thin concrete slab laid on steel or concrete purlins has been used. Considerable condensation occurs under such a roof in cold weather. Furthermore it is very difficult to keep a tin roof slab from being damaged by frost while being laid in cold weather.

If the shop is not to be heated in winter time corrugated iron laid on steel purlins makes a very inexpensive fireproof roof costing about twelve cents per square foot in place, including supports. It is fairly water tight but, of course, is very cold in winter.

There are, of course, many other kinds of roofs but the price for any roof comes between the limits here given.

There is not so much choice in the materials of construction of the side walls of a building as the roof. They may be of brick, stone, concrete, corrugated iron or glass. In this vicinity brick is the most usual and satisfactory material. Buildings with high stories are usually made with steel frames, the walls being simply curtain walls bricked in between the columns. Hollow brick should be used for the inside layer of brick to prevent condensation of the side walls.

Concrete for side walls is more expensive and less satisfactory than brick. Concrete blocks are sometimes used and are probably all right where enough cement is put in the blocks. Such walls are, however, weak, due to the lack of bonding between the blocks.

A twelve-inch common brick wall in this part of the country will cost about thirty-eight cents per square foot in place. With a good facing brick and some architectural decoration the cost may be increased to from forty to sixty cents per square foot.

In the modern factory building the question of material of the outside walls is not an important feature because from 75 to 100 per cent of the wall area is occupied with windows and doors. The old style shop building did not, as a rule, admit enough light. Our new buildings probably admit too much. It is a mistake to assume that a workman needs as much light to work by as there is out under the open sky. Too much light is almost as bad for the eyes as too little. Most of the inconvenience of working indoors comes from working with a strong light from one side which casts shadows. Windows should be so arranged that light will reach every point from at least two directions and be of as near the same intensity in both directions as possible.

Another question upon which there is usually some argument is the kind of windows to be used. The three types most in use are the standard wooden sash, the rolled steel sash and the fire underwriters' sash of sheet steel or copper. The under-

writers' sash is very little used for shop buildings because of the expense. They will, however, greatly reduce the insurance rate upon such walls of the building as have a bad fire exposure. Underwriters' sash cost about $1.00 per square foot, glazed with one-quarter inch wire glass and set in place.

The most satisfactory sash at the present time, for factory work, is the rolled steel sash. This is a comparatively new product, having been on the market for only a few years. Where large areas are to be glazed the small size of the steel muntins and mullions permits the maximum amount of light to enter the building. Several factories have been built with the side walls almost entirely of glass, the only obstructions in the walls being the columns and the brick work at the floor line. The cost of steel sash set in place and glazed with double strength glass runs from forty cents to forty-five cents per square foot, depending upon conditions. This figure was furnished me by the local agent of the Trussed Concrete Steel Co., who manufacture one type of steel sash. Steel sash have a few disadvantages which should be taken into consideration. The ventilation is usually secured by pivoting a part of the sash near the middle. In factories where screens are necessary it is not possible to have ventilation because the screen will not permit the ventilator to swing. In this northern climate storm sash are desirable because of the loss of heat through the glass by conduction. Steel sash are too heavy and too expensive to use for storm sash. If wooden sash be used the advantages obtained by the use of steel inside sash are lost.

The cheapest sash to use is undoubtedly the double hung wooden sash with which we are all familiar. Its cost is from twenty-five to fifty cents per square foot, in place. It allows of 50 per cent opening for ventilation. The details of window openings and connections to the remainder of the building have been worked out through long use and it can be made to fit any opening without additional cost. Where the window areas are large the wooden mullions and muntins must be made of considerable size for strength. This results in a considerable obstruction of light.

Four General Classes.

Considering now, factory buildings of more than one story, they naturally divide themselves into four general classes, ac-

cording to the materials of which they are constructed. This classification is really made by the fire underwriters inasmuch as the different types take different insurance rates. In fact, the rate of insurance is the consideration which most often determines the type of construction.

These classes are, frame construction, slow burning timber construction, structural steel and reinforced concrete.

In the frame construction class should be included all buildings having either brick or timber walls, wherein the floors are of wood and the joists narrow and spaced close together. Such buildings are, of course, the cheapest which can be built. By far the larger number of the present factory buildings are of this type. When an industry is in an experimental stage and the process of manufacture and the machinery are likely to be changed with experience, it is more economical to build in this manner. If a building is anything more than a temporary structure the extreme fire hazard, the danger to employes upon the upper floors and the lack of rigidity for supporting machinery are disadvantages which should be taken into consideration.

The insurance rate for frame constructed factories without sprinkler systems, varies somewhat between $1.25 and $2.50 per year, per $100 of insurance. The value of the contents of the building may equal that of the building. The rate on the contents will usually not be less than on the building.

Assume a rate of $1.50 each on the building and contents as a fair average. This makes a charge of $3.00 per year per $100 based upon the cost of the building. Suppose now that by erecting a better building we can get a very reduced rate. For instance, the insurance rate on the new Griggs-Cooper plant is eight and one-third cents per year per hundred, making a charge of sixteen and two-thirds cents based on the building alone. The difference in charges being $2.83⅓ capitalized at six per cent shows that it is a good investment to spend as much as $47 per hundred more on any building to make it fire proof. This consideration leads most prospective owners of new buildings to put up types which are more in accordance with the rules laid down by the fire underwriters.

If the frame type is to be used the insurance rates may be reduced about 60 per cent by the installation of the standard sprinkler equipment. This equipment will cost from five cents to fifteen cents per square foot of floor area, depending upon con-

ditions. That is, in a cheap building the cost of the sprinkler equipment will add to the cost of the building from 10 per cent to 20 per cent, but this cost is usually paid for in the first few years by the decreased insurance rates.

There is another loss to be considered, which cannot be covered by fire insurance, which is the loss of profits due to the interruption of business. This includes not only the current profits but also the loss of customers. In a growing concern this loss is generally more serious than the damage done by the fire.

In the slow-burning mill building construction as described by the fire underwriters, the walls must be of brick or stone. It differs from the frame construction in that the joists are spaced from three feet to six feet apart and are timbers of considerable size. The floors are matched planking. All stair and elevator hatchways must be enclosed, with doors at each floor opening. This construction is, of course, somewhat more expensive than the frame construction. Its principal advantage is that it takes an insurance rate about 20 per cent less than frame construction so that a building which would take a $1.50 rate in frame construction would take a rate of about $1.20 in slow burning mill construction. If a sprinkler system were installed this rate might be reduced to about forty-eight cents. The first cost of the building would be from 10 per cent to 30 per cent more than frame construction, with brick walls.

Any timber construction has several advantages over more permanent types such as concrete or steel. Alterations in the buildings, due to changes in processes of manufacture and the installation of new machinery, are much more cheaply and rapidly made. The expense of attaching shafting and machinery to the finished structure is considerably less. Wooden buildings are much more rapidly constructed than either reinforced concrete or structural steel buildings.

The columns in buildings with wood beams should be spaced from twelve to eighteen feet on centers. If a greater column spacing than this is required it is usually more economical to make the beams spanning in the longer direction of steel. These beams may rest on cast iron or steel columns, the remainder of the construction being of wood.

A better construction consists of steel columns and beams throughout. The floors may then be made of reinforced concrete or tile. If the columns and beams are then covered with

has produced. It is also the most expensive, costing from 5 per fireproof material such as tile or concrete the building may be regarded as the best type of building which modern civilization cent to 20 per cent more than a reinforced concrete building. Such structures are very commonly used in the east but there are very few factories of this construction in this vicinity. In such a building the steel columns do not occupy so large a percentage of the floor area as do concrete columns. Exact stresses in a steel frame building are more easily computed. The chance for variation in the strength of the material due to faulty workmanship or design is not nearly so great. Alterations of the building are more economically made in a steel than in a concrete building. The insurance rate for such a building as compared with a frame building, taking a $1.50 rate, would be about ninety cents per $100 without sprinkler system. With a sprinkler system this rate would be reduced to something like thirty-six cents per $100. In fact, many buildings of this type take a rate of from ten cents to twenty cents per $100.

The most popular type of factory building in this vicinity is reinforced concrete. In this respect we are way in advance of other localities. In fact, we probably have a larger proportion of reinforced concrete factory buildings in the Twin Cities than any other locality in the United States. This is largely because we have a number of contracting engineers of unusual ability, in this vicinity, who are financially interested in the sale of reinforcing steel entering into these buildings. Their influence is evident in the building ordinances of the Twin Cities, which allow higher unite stresses in both the concrete and the steel than are common in the cities of the east.

A properly designed concrete building is the very best building which can be put up for many industries. It is entirely fireproof and takes the same rate of insurance as a fireproof steel building. Such buildings are probably the most rigid type which can be constructed. The material will stand a large amount of abuse in the way of faulty workmanship and design. Other types of buildings deteriorate with age, but a concrete building increases in strength. So far as we are able to determine at this time our concrete building will be as good in the structural parts, fifty years from to-day as they were when built.

The floor spans of a concrete building may economically be made from sixteen feet to twenty-four feet in length. The ex-

act span for minimum cost of course, depends upon the expense of the foundations. The more expensive the foundation piers the longer may be the economical span. We find that the flat plate type of column pier is considerably less expensive than the old-fashioned masonry piers of the pyramid type.

The statements made concerning the exterior walls of one-story buildings are of course true, in regard to buildings with a greater number of stories. It is usually economical to build self-supporting, exterior walls for buildings up to three stories in height. For buildings higher than three stories the walls are often made twelve inches thick and carried upon the steel or concrete frame of the building.

The details of the work which have been described in the foregoing paragraphs are interesting, if at all, in illustrating the method by which we try to arrive at the final economical design. A factory is made up of such a large number of details that only a few can be touched upon at this time. The arrangement of electric lighting and the ventilating systems, so as to give each worker sufficient air and light, is another interesting problem.

Finally it may be said that in the last analysis the most economical factory building is the one where each worker is given the best conditions for doing his work, for the least cost.

Two valuable books upon this subject, from which a part of the data here given is drawn, are "Engineering of Shops and Factories," by H. G. Tyrell, and "Structural Steel Mill Buildings," by Milo S. Ketchum.

DISCUSSION.

Mr. George H. Herrold,* C. E. One of the problems in connection with factory construction is trackage. It has fallen to my lot in several instances to design a track layout for factory and industrial enterprises and I have been impressed with the fact in many cases that neither the architect, engineer or owner had given the matter of trackage any thought, relying on the supposition that after the land had been purchased and the building was up the tracks could be gotten to it some way. This is a serious oversight, as an important factor in the success of an industry is the quick and economical handling of the raw material to the factory and the finished product away from it.

In designing such trackage the engineer must not only be fa-

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miliar with the daily car requirements of the factory but also of railway switching methods in general and the particular switching services which can be obtained at this point from the company which will handle the cars. It would be exceptional conditions which would permit of more than two switches per day; one in the morning to place the cars and one in the afternoon to remove them. Railroad companies do not have switch engines waiting to place a car for you or to remove a load whenever you desire it.

My experience leads me to believe that designers of factories have little conception of permissible grades or curvature for practical switching, often resulting in requiring additional land for right of way and a longer track than necessary and even the building of trestle work of the making of excessive fills in order to bring the track to the factory at the proper level and give the length of track along the factory which should be level to permit shifting of cars during the day by hand.

As the common factory switch costs approximately $185.00 in place, track 82 cents per running foot, low trestles $9.00 per running foot and grading for the road bed about 20 to 50 cents per running foot, per foot fill these items of cost and the running maintenance should be taken into consideration.

You will receive and will have to accept monthly bills from the railroad company for patrol and track repairs, even on your own track, if the railway company are to operate their switch engines over it.

The simplest trackage possible is one switch and a stub track running along the factory, this may serve the purpose for small outputs but, in general a double end track is more desirable as it facilitates the handling of the cars. No switching can be done on a stub end track without disturbing all the cars and this will stop the loading and unloading of the cars at the factory during the switching operations. With a double end track cars can be set in from one end and taken away from the other. If the business requires a different class of cars for the finished product than for the raw material then the empties and loads can be placed at the factory doors in the morning, in the order required, and the loads and empties removed from the other end of the track in the afternoon without disturbing any cars not yet unloaded or being loaded.

Take for instance a linseed oil mill. The raw material consists of flax seed coming in in box cars. The finished product consists of oil and oil cake, the oil being shipped away in tank cars and the oil cake in box cars.

Where the business is large enough two or more tracks are preferable to one. One track should run on each side of the factory; one for raw material loads only and the other for loading and out-going loads only.

In general each track should have a car capacity between the clearance point of switches equal to twice the number of cars to set on it. This permits the moving of the entire string of cars past the factory by hand, using a pinch-bar or car-puller between regular switching.

A factory of this size should be designed to begin its processes on one side of the factory and deliver the finished product on the other side ready to be loaded into the cars in order to eliminate cross handling.

Track scales and track must also be considered. Scales should always be under cover and where possible on a separate track from the loading, and unloading track. If the factory track should be on a curve the scales track must be so built as to provide a straight track on the scales and for forty feet on each side and if the same track must be used as a thoroughfare track then dead rails must be provided. These two latter provisions are required by the Minnesota Railroad and Warehouse Commission.

It would therefore appear that the economical design of factory buildings involves the following problems in approximately the order given:

A study of the processes to be carried on in the factory.

The design or selection of the machinery.

The layout of the machinery and determination of floor space.

The layout of yard room.

The determination of the daily car requirements.

The investigation of switching service in the locality selected for location.

The design of the track layout desired.

The fitting of buildings and tracks to the ground owned or available by actual surveys.

The general revision of all plans to compromise with conditions.

Mr. King has given us a very valuable paper on this subject

and has clearly brought out the larger number of the problems above mentioned.

In his "Cost of the Manufactured Commodity" Mr. King has given under item *2* the cost of transportation of raw materials to the factory and under item *6* the cost of distribution. I have tried to amplify these two items in the foregoing discussion as they are largely affected by trackage facilities and closer attention to this phase of the problem may save years of grief. A first class factory poorly located with reference to trackage, resulting in awkward switching facilities, is only half a factory.

[NOTE—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

THE LAW OF CONTRACTS.

By A. A. Aegerter, Member of The Engineers' Club of St. Louis.

[Delivered before the Club, November 19, 1913.]

Introduction.

What I have to say to-night will govern all contracts, except those in which marriage and love are considerations.

To introduce the title:—Why do we have the law of contracts? It is to provide rules of action to govern society in this branch of the Law. Throughout stress will be laid upon the enforcible contract. One may say, why bother with the law?—Why have them? And further state, we have been contracting for fifty years and never knew what the law was, and never had any trouble. A true statement, but suppose there had been some trouble namely, a breach, and the contract was not enforcible in a court of law, then the injured party could not have redress, and for that reason it is very important that all contracts should be enforcible contracts.

Definition.

What is a contract? Is it a legal document, written with cold black English letter captions?—No. An enforcible contract could be written on a postal card in lead pencil or even spoken or implied by actions. A very good definition tersely stated is: "A contract is an agreement in which each party undertakes to do, or not to do, a particular thing."

A Contract Must Not be Unilateral.

A contract must always be bilateral, never unilateral, because you cannot contract with, or sue, yourself.

Kinds of Contracts.

Contracts are of two kinds:

1. Express contracts.
2. Implied contracts.

The express contracts are those which are fully expressed by the parties at the time of the execution of the contract. For instance; an ordinary building contract:—the plans and specifications express one consideration and the money payment is the other.

An implied contract is one in which the terms are not expressed when the contract is entered into; the law then presumes and implies the obligations. For instance: On a Sunday morning you might be sitting in your library, after a 6-inch fall of snow; someone cleans your walk and taps on the door for the fee. There is an implied contract,—implied by the law. Under certain conditions one may go into a store and pick up a book,—put it under his arm and walk out with it,—also an implied contract that he bought the book and is liable for the price.

Essential Elements.

In every enforcible contract there are four essentials, namely:

1. Competent parties.
2. A lawful subject matter.
3. A lawful consideration.
4. A mutual consent.

Competent Parties.

There are two kinds of parties, artificial and natural persons.

The natural parties have three requisites. They are persons of lawful age, of sound mind, and of no legal disability. A man 21 and a woman 18 may contract. One must be capable of giving or refusing assent with full realization of proposed acts and consequences. One must not be under any such disability, as will in the eye of the law, render the contract void.

The artificial parties are corporations. They are created by the law; their powers are found in their charters. The thing to watch with a corporation is to see that the proper authorized parties sign the contracts; that they are properly sealed and the contract is within the scope of the charter of the corporation. If it is without the scope, the contract is void.

Lawful Subject Matter.

The subject matter and the consideration are co-terms, and a lawful subject matter is one that does not contravene the law: that does not promote bad morals, or indecency, or one that is not against public policy. Nor can an enforcible contract exist if it is founded upon an impossible subject-matter. For instance; if a contractor contracted with an owner to build a house, the existence of which would promote bad morals or indecency, in the City of St. Louis, money to be paid when the

building was finished, the owner would not have to pass the consideration because the subject-matter of that contract is unlawful.

The City Code provides for the erection of buildings in the third class not to exceed 70 feet in height. If anyone enters into a contract to build a third class building 100 feet high, payable at completion, and the building is completed, the owner does not have to pass the consideration and the contractor cannot recover in a court of law, because there is an unlawful subject-matter in the contract.

Suppose a contractor made a contract to build a bridge and there were some irregularities in the workings of the Government by which that franchise was granted, and the bridge was built, payable at completion, or say it was payable monthly, and there was a payment coming due of $200,000 and it was discovered that there was some irregularity. No recovery could be had of money outstanding, due to the fact that the contract has an unlawful subject-matter.

Irregularities of this kind are against public policy.

A contract to build a Keely motor would be a good example of impossible subject-matter. One could not even start litigation.

Lawful Consideration.

The courts will not look at the adequacy of the consideration, —$1.00 will pay for the Barr Block in a contract, provided there is no fraud; no deceit; no undue influence. With the same trend of thought on the other hand, $1,000 will be considered a good consideration for a canary bird.

It may be well to watch, in contracting with foreign countries, that the kind of money you are to get is definitely stated in the contract.

Now if there was a contract made between parties in fiduciary relation and there was no undue influence exercised, that contract would be set aside by reason of the failure of consideration in favor of the weaker one, if legality was at issue.

Mutual Consent.

The mutual consent of the parties, or the meetings of the minds can best be exemplified in a building contract. The mind of the owner is pictured in the plans and specifications. These

are handed to the contractor for an offer or proposal, which proposal is accepted by the owner or other party by signing the contract. That document then will be evidence of the meeting of the minds of both parties, due to the fact that the plans, specifications and proposal represent the minds of both of the parties. Without the meeting of the minds there can be no contract. If there is an undue influence used upon either party, the contract could be set aside, due to the fact that there never was a meeting of minds.

Discharge of Contract.

Now we have a contract that is enforcible. It has the four essentials, namely:—

Competent parties.
Lawful subject-matter.
Lawful consideration.
Meeting of minds or mutual consent.

What are we going to do with the contract?—we cannot let it run forever: No, it must be discharged. Every contract must be discharged, otherwise forever there would be obligations left here for our heirs, administrators, assigns and successors.

Then how can we discharge a contract?—We can discharge a contract in four ways:

1. By performance.
2. By mutual assent.
3. By impossibility of performance.
4. By Breach.

By Performance.

Both parties to the contract must have done all that the contract required them to do. As, for instance; in a building contract, completion of the building, and the payment of same:—the contract is discharged without liability.

By Mutual Assent.

Suppose I contracted for a million brick, 50,000 to be delivered and paid for weekly. After one-half were delivered, I felt as though I did not need any more. I get in touch with the other party to the contract delivering the brick, and it is also

convenient for him to be relieved of his obligation. He then relieves me of my obligation and I relieve him of his obligation. That contract would be discharged by mutual assent, withut liability.

By Impossibility of Performance.

A contract may be impossible of performance at the time it was entered into, or it may become impossible of performance through events subsequent to its making.

A contract to do a certain thing, which both parties to a contract at the time of making, knew to be physically impossible of performance, imposes upon neither of them an enforcible obligation. A contract to do a certain thing which is legally impossible is void and consequently impossible.

A contract founded upon the supposition and belief by both parties thereto that a certain thing is in existence, when in fact it later develops that the thing never did or has ceased to exist at the time when the contract was made, is void.

Beyond the aforesaid, if nothing is mentioned in the contract relating to impossibility of performance, an Act of God is the only thing that will excuse the impossibility of performance of a contract.

By an Act of God, is meant some manifestation of nature to which man has not contributed and which he can neither control or overcome, such as earthquakes, tempests, cloudbursts, lightning and fire it kindles, blizzards and hurricanes.

Now if the enterprise is destroyed by any one of these six things, the contract is discharged, without liability to either party. It may be well to remember that one can contract to assume any liability or to contract his liability as the parties see fit.

By Breach.

A contract may be breached in three ways:

1. Renunciation of the contract.
2. By rendering the performance of a contract impossible.
3. By either partial or total failure of performance.

By Renunciation.

Suppose a Bridge Company tendered a proposal of $4,000 for a bridge for a county, we will say, and signed a contract to erect it. Later while getting out its bill of material it discovered that it had made an error and that bridge was really going to

cost them $6,000. It may go to the county officials and say, we have made a mistake,—we would like to have you re-let this job and we will pay for the re-advertising. The county officials may say, oh no! That will not do at all: you renounce your contract and then we will re-advertise, let the contract to the lowest bidder, and you pay the difference in prices. There is a liability from the discharge by breach; namely, a renunciation. That is, the contractor has renounced before he starts.

By Rendering the Performance of a Contract Impossible.

Suppose that I am a painting contractor and have entered into a contract with a man to paint his building, and his building burns down,—not by reason of lightning, but mere destruction by fire before I performed any of my part of the contract. I can then recover by reason of that breach,—not my fault, not his fault,—the profits which I anticipated in my painting job. Or if I am going to erect a pair of boilers in a certain plant, and the plant burns down, and he writes me, "I do not need the boilers erected,"—he is liable by way of that breach,—by rendering the contract impossible, he is liable to me for my profits. But if this plant had been destroyed by earthquake either before erection or during same, nobody would be liable.

Total or Partial Failure of Performance.

Now as these cases are very familiar to us, I won't go into them other than saying that a contract is broken when either of the parties thereto fails to perform any of the material terms or conditions.

Rights and Remedies.

Now after these contracts have been breached and discharged what is the result?

A damage results from three kinds of discharges. In the other three there is no liability. If a contract is discharged by performance there is no liability; if it is discharged by mutual assent there is no liability; if it is discharged by an impossiblity of performance there is no liability, but if discharged by renunciation or rendering it impossible of performance, or by total or partial failure of performance, then there is a damage flowing from it.

Damage.

Damage is of three kinds:

1. Specific performance.
2. Penalties.
3. Liquidated damages.

Specific performance is a remedy in equity and is only granted in that class of cases wherein the law will not afford a full, complete and adequate remedy, wherein the injury resulting from the breach is of such a nature that it cannot be measured, or compensated for in charges. This proceeding is called Mandatory Injunction. In example: suppose a corporation buys a tract of land from different individuals, and intends to build a plant, and the contracts to buy are made. Subsequently, the party owning the middle tract refuses to convey his property. Now without this piece of property this plant cannot be built. Mandatory Injunction is then filed in a court of equity which forces the party to convey the property. There is no damage of specific performance in a court of law.

For, if one contracts to buy a residence, and subsequently the owner refuses to convey the property, the recovery can only be had at law. We can only recover the damage the jury sees fit to give us because we can buy elsewhere, but in the other case, large holdings have already been acquired and the plant cannot be run without that piece of property.

Penalties and Liquidated Damages.

These terms are not synonymous. If the contract is written with a damage clause, and that clause contains either the term liquidated damage or penalty, provided that it is a reasonable income on the money invested in the enterprise that is being built, and further that penalty or liquidated damage is embodied for the purpose of covering a damage by reason of not finishing the enterprise on time, then that clause will be looked at as a liquidated damage. If it is unreasonable, it will be looked at as a penalty. Penalties are not allowed. Each one only takes the place of the actual damage.

Suppose we have a $150,000 building under contract: 6 per cent on that money is $9,000 or $25 a day. If the contract provided for a liquidated damage of $25 a day and the building was not finished on time according to the terms of the contract, the contractor would be obliged to pay that $25 a day for each and every day after the date of completion as per contract terms. But if a contract was made for that same proposition with a liquidated damage of $100 a day, the court would rule that this amount is unreasonable and therefore, is a penalty. The court will set the $100 a day clause aside and the owner

must then show that he has been really damaged before he can collect any damage.

Now as far as I am concerned, if I were to enter into a contract with a short time duration; say to put up a $100,000 building in four months, I would much prefer to sign that contract with a liquidated damage of $1,000 a day than if it was only $20 a day, because if you did not finish, and it was $1,000 a day, the court would set that aside as a penalty and the owner would have to prove that he was really damaged before he could recover, but if it were $20 a day the court would decide that it is a liquidated damage, and that is what you are obligated to pay, so don't get these two terms interchanged.

INTERPRETATION.

We come now to the construction of a contract by the court.

When a contract is written so that the language is ambiguous then only it is the duty of the court to unravel and determine what the intentions of the parties were, for the intentions of the parties govern in these cases. They cannot look into the minds of the parties to ascertain this intention, but look to the occasion of circumstances which give rise to the contract, ascertain the relative position of the parties at the time contract was made and analyze the object to be thereby accomplished by the parties thereto.

The whole document will be considered in determining the meaning of all or any of its parts.

Words in a contract are to be understood in their plain ordinary and popular use, unless they have generally, in respect to the subject-matter, as by known usage or trade acquired a peculiar sense distinct from the popular sense of the same words.

In a printed form, the written parts of it will be given weight in preference to the printed part, when there is a contradiction between the two, because it was written by hand—written at that time. The printed part may have been overlooked.

Errors in grammar will not defeat the plain intent of the contracting parties. A contract should always be written on one sheet of paper, because if it is on two sheets, signed on the last sheet and pinned together, it is a very easy matter to fraudulently remove the one not signed and replace it by another, and then you still have a contract properly signed, therefore a con-

tract should be written on both sides of a sheet of paper if it runs over one sheet.

Recapitulation.

The essential elements of any contract are as follows:

1. Two parties with capacity to contract.
2. A lawful subject-matter.
3. A lawful consideration.
4. Mutuality or a meeting of minds.

Without these four elements no contract is binding in law. Besides these the essentials of an engineering contract are as follows:

1. A proper form.
2. A description of the parties.
3. A preamble.
4. When and under what conditions the contract is to become operative.
5. The time duration of contract.
6. What each party obligates himself, his executors, administrators, successors or assigns to do or not to do.
7. Description of consideration each party is to receive.
8. A clause relating to impossibility of performance.
9. Liquidated damages clause.
10. Sub-letting.
11. Arbitration clause.
12. Bond.
13. Date.
14. Signature.
15. Seals if necessary.
16. Witnesses to signatures.

This, gentlemen, covers the field of contracts, and with this illustration one may either approve or draft a contract.

DISCUSSION.

Mr. John Hunter. I am not sure that I understood Mr. Aegerter correctly when he said that a contract should be written on two sides of the paper.

Mr. Aegerter. It should be written on one sheet of paper.

Mr. John Hunter. Suppose it took a number of sheets, would not the regular form of initialing each sheet cover the requirements?

Mr. Aegerter. There are a lot of chances for fraud there. Suppose some one forged an initial, which is a very easy thing to do, whereas it is a hard thing to forge a signature. They could slip a piece of paper out of the document and forge a new initial and still have the paper with the signature on it. If it is essential that you have several sheets, they should be fastened together so that they cannot be taken apart. That is the reason why contracts on forms are always on one sheet of paper.

Mr. John Hunter. There is another point I am not clear on; that is, in regard to a building being destroyed by an act of God. Does the contractor get any recompense for the work he has done on that building?

Mr. Aegerter. The court will leave the parties just as it found them.

Mr. John Hunter. So the contractor loses what money he has spent on the job?

Mr. Aegerter. Yes.

Mr. John Hunter. The reason I bring this up is that when letting contracts for the construction of the east wall and its foundations of our Ashley street plant, there were two companies that started the job and were unable to complete it, due to the river running unusually high. The contractors lost a good deal of money and went into court and tried to get the Union Electric Light & Power Co. to pay them the money that had been spent, but they could not get a dollar above the money they had received.

Mr. Aegerter. That complies with the rules I have given.

Mr. John Hunter. It complies absolutely with the rule you have given.

Another point: They found it impossible to lay the foundations at the elevation originally planned, and in the meantime the American Bridge Co. had manufactured, according to the original plans, $150,000 worth of steel that could not be used. They were in litigation for seven or eight years, and it was decided that it was an act of Providence that resulted in the change in position of the foundations and the consequent impossibility of using the steel ordered from the American Bridge Company. But the Union Electric Light & Power Co. had to pay $115,000 for the $150,000 of steel.

Mr. Aegerter. Well, was that breach caused by an act of God, or was it caused by the Union Electric Light & Power Company?

Mr. John Hunter. It was caused by an act of God. The contractors could not get the foundations in as contracted for, and through changing the foundation plans the steel could not be used.

Mr. Aegerter. Who was the contractor putting in those foundations, the American Bridge Company?

Mr. John Hunter. No, another contractor.

Mr. Aegerter. Very well, then the Union Electric Light & Power Co. had breached their contract by rendering the contract impossible. If the Union Electric Light & Power Co. had placed the foundations then the American Bridge Co. could have placed their steel.

Mr. J. T. Garrett. I have been writing contracts for the last 23 years, and backing them up with my own money. I find that the less polishing you have on them by lawyers and the further you can keep the lawyers away from your contracts, the better off you are. I also find that the decisions of the courts are absolutely an unknown quantity. You cannot tell anything about them so far as damages are concerned. In one case they will do one thing, and in another case another thing, under exactly the same circumstances. The contract is really a very unimportant thing, anyway. The plans are vastly more important than the contract. Now, as far as I am concerned, I would just as soon have the contract written in a few lines; that is, I simply agree to build according to the plans and specifications, and nothing more, because, as Mr. Aegerter says, the damages, even if specified, may be construed as unfair. Damages generally have to be proven, anyway; that is, the owner generally has to prove his damages, whether specified in the contract or not, and the same question would still come up as to whether or not the damages claimed, were fair. Sometimes, however, the court holds that the damages, if specified, are fair, because they are specified. I have known of court decisions where it was held that whatever was specified in the contract was fair, and in other cases damages had to be proven. In public work, it is difficult to prove damages of any kind, because there is no one that can say he is materially damaged. In building a street, sewer or bridge, if the contractor does not complete the work on time there is no individual that can say he is damaged to any great extent, and consequently it is very difficult to prove and collect damages on public work.

But there is very much more to contracting than just simply

writing agreements between the first and second parties. For instance: In recent years, the different states have passed so many laws relating to licensing of foreign corporations to do business in the states. A contract made by a corporation to perform an act in a state in which it has no license to do business is not legal and cannot be enforced by the corporation, notwithstanding the fact that the contract may be perfectly clear as between the parties. There are so many things to consider that it is hard to get a contract that is in exactly legal form unless both parties act in good faith. I think it is also important that the buyer of work give bond as the man that is taking the contract, because the buyer of work beats the contractor oftener than the contract beats him. He usually gets his work before he pays the money, and frequently he does not pay for it at all. There is a great deal that might be said on contracts. If it were merely a matter of getting things in a contract, it would be easy enough to get up a stereotyped form and use it at all times, but there is a great deal more than that to contracting. Every contract is more or less different, and I do not believe that one can get up any form that will apply to all jobs.

I did not quite understand Mr. Aegerter when he said that if a building were destroyed by an act of God when it was but partially completed, as to who would be responsible—whether or not the contractor would have to replace the work or whether he would be released on account of the work being destroyed by something that was no fault of his.

Mr. Aegerter. It would be nobody's loss. The court would leave both parties just as it found them at the time of the accident. The contract would be discharged. There are no more conditions or obligations in it at all. The contractor would not have to re-erect the building, nor would the owner be obligated to pay any money.

Mr. A. P. Greensfelder. Mr. Garrett has raised a very interesting point regarding payments. Deferred monthly and final payments should draw interest.

Mr. W. S. Mitchell. I am afraid I cannot add to the subiect very much. My experience with contracts has been in drawing them so tight that a contractor cannot wiggle out of them. Government contracts are sometimes so one-sided that people have refused to bid, or as they express it, to tie up their heirs and assigns forever.

Mr. J. T. Garrett. The Government has a decided advan-

tage, because very few people would fight the Government, as what they say is usually law, but with individuals it is different. They do not have the backing the Government has.

Mr. A. P. Greensfelder. Is it not usually the case that the contract is written by the owners or their representatives and the man taking the contract is obliged to sign it? He has very little leeway in the arrangement, but if he doubts the sincerity or fairness of the engineer in charge he had better not accept the contract.

Contracts, as I have found them, have been written by the interested party and given to the contractor to sign, and he might as well sign them without reading, as by reading he cannot change them.

Mr. Richard Morey. Mr. Chairman, you have expressed it well, that contracts are drawn usually by the engineer or by the owner and his lawyer. The contractor is usually required to accept the form of contract when he makes his bid and to deposit a check to guarantee that he will sign it. Most of those forms contain clauses the requirements of which are impossible of performance without any "act of God."

Mr. Aegerter referred, in the latter part of his discussion, to contract provisions for an arbitration board. A committee on forms of contracts recently reported to the American Railway Engineering Association but did not recommend an arbitration clause, and those who discussed the report agreed that such provision should not be included. Most of the contracts which my firm has had provided that the final decisions shall be made, on all questions, by the chief engineer, and I am convinced that it is better for us to have the chief engineer write himself into that rather delicate position whereby he becomes for the time being, the contractor's engineer as well as the owner's. An arbitration is too often merely a path that leads only to a court. I have seen the operation under the arbitration clause and it usually increased troubles. It seems best to me to leave decisions to a man who has been schooled under the old forms of contract during the time it requires to climb to the position of chief engineer.

Mr. John W. Woermann. Mr. Garrett rather intimated that a contract was not a simple thing. I agree rather with Mr. Aegerter on that, at least as far as Government contracts go. They are simple. There are only two forms that cover all the contracts that the Government enters into through the Corps of

Engineers, U. S. A., forms 19 and 19a, which are practically the same, except that the latter provides for liquidated damages. Whether it is a steamboat, a dredge, a barge, a lock, a dam, a levee, or some bank revetment, the form is the same. The subject-matter is referred to as a dam, or a piece of bank revetment, or whatever it is. The specifications are the most important part and the only part in which any special skill or knowledge is required in the preparation. In regard to the liquidated damage feature—in the last two years in the Government contracts, usually only a small amount has been put in—as Mr. Aegerter says, about what the interest on the investment will amount to. However, in some cases when plant is purchased, a steamboat or a barge, to be delivered at the beginning of the season, and the contractor is unable to deliver it until the middle of the season—in that case there might be considerable damage done, from the fact that the plant could not be used during that season, but that is not usually the case. Two other forms cover all the general paragraphs for all specifications, forms 41 and 41a, which are practically the same, except that the latter must be used when the eight hour law is applicable.

Mr. A. P. Greensfelder. Is there an arbitration clause in Government contracts?

Mr. John Woermann. No arbitration clause.

Mr. J. T. Garrett. Since Mr. Woermann has said that Government contracts are so simple, we will suppose, for instance, I take a contract with the Government under the eight-hour law to build a bridge. I am supposed to work but eight hours in my shop. A certain amount of that material I buy—for instance, I buy the steel from the rolling mill. Does the rolling mill man have to work but eight hours, also? If not, suppose I take a contract from the Government and I only do a very small portion of the work in my shop, and I find I can get it done on the outside in a ten-hour shop cheaper than I can do it myself in my eight-hour shop,—how far back does the eight-hour law extend? Now, on the erection of that job, on the ground, I suppose I would have to work under the eight-hour law, but where does the application of the eight-hour law commence? That is what I would like to know.

Mr. John W. Woermann. Mr. Garrett is discussing the interpretation of the eight-hour law.

Mr. J. T. Garrett. Well, the contract should cover that to be clear. You say they are clear.

Mr. John W. Woermann. That is not a simple matter, and has not yet been settled. Those decisions are coming in every few weeks. That is all by reason of the fact that Congress has passed three different laws bearing on the eight-hour requirement and they overlap a little; not one of them is entirely clear, and a great many such instances come up, just as Mr. Garrett has intimated and he has indicated, too, the general theory on which it has been decided. Mr. Garrett, for example, buys a lot of material there, as it is rolled or fabricated, from another mill. The Government does not attempt to supervise the manufacture of the material. It simply requires that whatever he shall do in erecting the bridge or barge, or dam, has to be done under the eight-hour law.

Mr. J. T. Garrett. But I might not do any of it, if I can get some one else to work ten hours and do it for less money. Have I got a right to let the steel to a ten-hour shop?

Mr. W. S. Mitchell. The Attorney General is the only authority who has given decisions upon the eight-hour law. The courts have not yet had it brought up to them. To bring a concrete instance—the American Bridge Co. has a contract for building certain vessels, and they were informed by the Attorney General's department that in their own shops they might make and do as much work as possible on the various parts of those vessels in 10 hours, or any other time as they chose to operate, but when they brought the parts out on the ways and began to assemble them into the construction on the vessels, eight hours was to apply.

Mr. J. T. Garrett. Well, what I am trying to illustrate is that a Government contract is far from being clear, and that a Government contract, as a contract itself, does not cover the ground.

Mr. A. P. Greensfelder. In that connection I might mention a request that was made on the local section of the Engineering Contractors. Someone had introduced an eight-hour law in Missouri applying not only to state contracts but to county and municipal contracts. We were asked to state the position of the Engineering Contractors on this subject. A meeting was held, and in a general way we agreed that we did not see how we could control the manufacture of materials before they were delivered to the site of the work. Whether it should be eight

or six hours on the site is a matter of public policy which the legislature should decide. A railroad transporting materials runs 24 hours a day and is a common carrier that enters into the construction of every piece of work.

Mr. J. T. Garrett. There are lots of goods delivered to the Government without any work being done to them after they are unloaded, as, clothing for their soldiers. There is no provision that clothing shall be made under the eight-hour law. Do you aim to say that that law does not apply at all to cases of that kind—where no work is done on the ground—that the eight-hour law does not apply at all in the factory? I know there have been Government contracts, even for levee work, where they held that work done entirely away from the site, should be done under the eight-hour law.

Mr. W. E. Bryan. Large corporation contracts, involving large amounts of money, of course, are signed by officers of the corporation, and contracts involving small amounts are usually signed by employees. The reasons are evident, but I would like to know just how they stand legally. Has the employee the right to sign a large contract, or is there any definite understanding?

Mr. Aegerter. There are only two officers, and those officers are always designated in the charter at the time of the creation of the corporation, who are duly authorized to sign for the corporation, and if the contract is such that it must be in writing, which are all contracts that cannot be completed within a period of one year, then those two officers must sign, and if their charter provides that all contracts, say, over the amount of $30, must be in writing, then those two officers must sign.

Mr. W. E. Bryan. Suppose that is not provided—nothing said about it.

Mr. Aegerter. Then it would be a case for the court to decide who are the proper parties to sign that contract.

Mr. Max Rotter. I should infer from what Mr. Aegerter said that a penalty is not enforcible. Is that so?

Mr. Aegerter. That is correct.

Mr. Max Rotter. Suppose I have a contract to furnish you with a building for $100,000—that to be the whole value of the structure—and I have a number of small contractors working on it, and one man whose contract is for $1,000 does not finish

his portion of the work on time, can you collect from me liquidated damages on the whole $100,000?

Mr. Aegerter. Providing your contract is not completed then. You are the general contractor and you are to deliver to the owner the building on the 6th day of November. On the 6th day of November you must deliver it or you are liable. It does not make any difference who caused you not to deliver—you must do what you contracted to do, otherwise you are liable.

Mr. Max Rotter. Very well. I make contracts, for different parts of the building, with different contractors. The whole building is of no use to me until those contractors have fulfilled their contracts. I make a contract with one man for $1,000—say, for 1 per cent of the value of the whole building—can I hold him for the whole amount?

Mr. Aegerter. No, he is only liable in liquidated damages for that amount which would be reasonable on the $1,000 consideration.

Mr. Max Rotter. What is that?

Mr. Aegerter. That is a case for the court and the jury to decide. That reasonable value has never been settled, I believe.

Mr. Max Rotter. That would appear somewhat unfair. Take the other side, for instance. I have known of a case where a manufacturer had entered into a contract to perform a certain piece of work and subcontracts were made with people to supply different parts. The manufacturer was unable to fulfill his complete contract because of the failure of one of the subcontractors for a small item. Now, would that have to go to a jury?

Mr. Aegerter. Was the contract breached? In other words, did that man deliver that property to the owner as per contract? Let us take a concrete case. Suppose we were building a tug boat and I am the contractor. I make a contract with you to supply me with the engine, and I have contracted with the corporation to deliver the tug boat complete to them on a certain day. Your shop burns down, the machine is destroyed, therefore you cannot deliver it to me and I fail to deliver the tug boat complete. I am liable for the liquidated damages, if the liquidated damages are reasonable, because I breached the contract. It is not an act of God that your shop burned down; it is not an act of God that you failed to deliver the engine to me and that I failed to deliver the tug boat to the owner, it is my breach and I turn around and hold you.

Mr. Max Rotter. Do you tell me you can hold me for the full amount?

Mr. Aegerter. I can only hold you for the engine contract and interest.

Mr. Max Rotter. If the whole contract law is as full and clear as you state, why is it necessary to write all this matter into the contract? You recommend that it be put in. Why don't you simply state that the contract shall be interpreted according to the laws of a certain state? I have lately had much to do with contracts and it has been burdensome to read through 20 pages of general conditions and find only one small page of specific requirements at the end of it. If the law is so simple and clear, why write these 20 pages? Why spend an hour and a half telling me what the liquidated damages are? Why not say that this contract is to be interpreted under and carried out according to the laws of Missouri, and be done with it?

Mr. Aegerter. If we take that view of the matter, and the liquidated damages are not specified, then the owner has the burden of proving that we really was damaged, to recover on a breach of time.

Mr. Max Rotter. If that is the law, why tell me through a page and a half that he has to prove it? If the law is so clear and straight and simple, why is it necessary that all this be restated in the contract?

Mr. Aegerter. For this reason: As a concrete case, if a contract provides for liquidated damages that are reasonable, that does away with the owner proving liquidated damages, whereas if there were nothing said, the owner would have to go into court and bring in a dozen witnesses to prove that he was damaged even to the extent of a reasonable amount.

Mr. Max Rotter. Why state all these points in a contract as you recommend, if they are the law?

Mr. Aegerter. Just for that reason. I do not believe that I made the statement that you should define the penalty, specific performance and liquidated damages in a contract, but provide for the liquidated damages in a contract—not define it.

Mr. Max Rotter. How about a breach—the same thing?

Mr. Aegerter. Yes. For instance, if I build a bridge and I do not want to be liable in case of a flood, I should state that in the contract, because if I do not some jury might state that that was not an act of God.

Mr. F. D. Purdy. How do you take care of the strike clause?

Mr. Aegerter. That comes under impossibility of performance.

Mr. F. D. Purdy. Is it a good thing to have a strike clause?

Mr. Aegerter. I could probably enumerate a hundred things that should go in there. Each particular enterprise has its own things which should go in that particular place.

Mr. F. D. Purdy. There is another thing in connection with contracts; that is, for all to see that they have a license to do business in the state in which they enter into a contract. This has been pretty hard for a good many people, and I think should be a prominent thing to bear in mind. Before signing a contract see that you have your license.

Mr. J. T. Dodds. I have about come to the conclusion that the less you say in a contract, beyond the bare recital of the objects to be accomplished, the better off you are. Try to know your contractor and explain to him what it is you are going to require of him, and what he can expect from you, and go ahead and do the work. Then the engineer and contractor having the same idea of the work and how it should be done, and each one being willing to do his part in the manner he should, there should be but little trouble in settling any question in relation to the contract—of course, I am speaking of private, not public contracts.

Now, Mr. Aegerter has given us a very concise and instructive talk and made things very plain from his point of view, and also from the viewpoint of most of us, but, unfortunately, the courts do not always seem to see things in the plain, straightforward way in which they have been pointed out to us to-night. As an illustration of the different ways of looking at the same thing, I remember a case where a sewer contractor took a contract to build a sewer in the western part of this city. The plan had been made by a young man at the City Hall from the profiles on file, and without taking any levels on the street over which the sewer was to run. Unfortunately the street levels had been lowered considerably since the profiles of the street had been made and, consequently, there was considerably less excavation in the sewer trench than the profiles showed. The contract stated that the work should be done according to the plans and specifications. After the work was done, the owner found that the contractor had not done as much excavation as was shown to be necessary by the plans and felt that he was entitled

to a rebate for work not done. Well, the contractor thought different and the case went to court. At the first trial, the contractor made the point that it was impossible for him to lay the sewer at the depth below the street surface shown on the plans. as that would put the sewer below the outlet sewer with which he was compelled to connect. But the judge stated that that made absolutely no difference. He said the plans and specifications stated that the sewer should be laid a certain depth below the surface of the street, and if in order to obtain that depth it was necessary to stand the sewer on one end and go to China, as the contract called for it, that was what the contractor had to do, or make an allowance for the difference in the work to the owner. However, the case was passed to another division of the same court, and the next judge took a diametrically opposite view of the matter. He stated that the object of laying the sewer was to furnish drainage to a certain piece of property, and it did not make any difference how deep it went into the ground, the owner got what he wanted in the way of drainage and would have to pay the full contract price, and he rendered his decision accordingly.

So far as an act of God terminating the contract between parties is concerned, I remember a case of a building on Westminster place east of Boyle avenue. The building was destroyed by a storm when it was above the second story and the walls were completely blown down. The brick were laid aside, the plans revised and another kind of brick used, but the party who furnished the first brick brought a lien against the building and got a judgment for his claim.

Another case I recall is where a quarryman furnished stone to a certain building; the stone was rather green and soft; a hard frost came on; the stone cracked and went to pieces and was taken out of the building. The quarryman brought suit against the owner, judgment was rendered in favor of the contractor and he was paid for the stone that had been taken out of the building and not used.

So you can see that, although the law of contracts, as Mr. Aegerter has explained it to us, is very positive and definite, when a case once gets into court, it is by no means so plain who is going to win the suit.

Mr. J. B. Van Vleck. I have a great deal of sympathy with the contractor, for I believe that most of the city contracts I saw,

particularly in New York, were impossible of fulfillment. There are a lot of clauses in the contracts that are being defeated right along in the courts, and still the corporation counsel for the City of New York, who reports legally on what goes into the municipal contracts, keeps on putting these clauses in the contracts, even though the courts are deciding against them all the time. There is the "liquidated damages" clause for example; yet no contractor finishes his work on time. In spite of that, he does not have to pay damages, although the clause is in the contract, and I know of several other clauses that are being retained in contracts without any apparent reason.

Mr. C. L. Hawkins. There is one thing I would like to ask about in regard to the Ashley street plant. In that case, was the steel company required to guarantee results, or were they required to design the structure to do certain work?

Mr. John Hunter. They designed the steel in accordance with the original foundation plans given them.

Mr. C. L. Hawkins. They were furnished the information and had no men on the work to see that the foundations were properly designed or to see that they were given the correct information?

Mr. John Hunter. Yes, they had men on the job to see that the foundations were properly designed.

Mr. C. L. Hawkins. In other words, they practically guaranteed their work.

Mr. John Hunter. The erection of it, yes, but through an act of Providence it became impossible to set the foundations as originally intended, and the steel work had to be changed. The first contractors who were supposed to put in the foundations and could not do it lost the suit, and did not get anything. It was held that in as much as this was an act of Providence, the Union Electric Light & Power Co. was not liable for the amount of money spent on the job. The American Bridge Co., however, got their proportions for the steel they had manufactured but could not erect.

Mr. Richard Morey. I think the term used, "an act of God," is something of a misnomer. It would seem merely to beat the contractor out of his money, and that is what Mr. Hunter did to his contractor however legally it may have been done. In effect Mr. Hunter said to him: "Build this building where I lay it out and after my plans and under my inspection."

I believe we would show more reverence for the Eternal Justice which rules the universe if we called it something else than "an act of God."

Mr. John Hunter. I believe we took the Government records of the stages of the river, and there was no record of a 38-foot rise in the river at that place.

Mr. Richard Morey. No, but the Union Company selected the place.

Mr. John Hunter. He knew the conditions of those contracts just the same as the Union Electric Company.

There was one point that Mr. Bryan brought up with reference to authorizing persons to sign those contracts to which I might refer. I have personally signed contracts up to $30,000 with no objection on the part of the contractors, and it is a common occurrence for persons in Mr. Bryan's position and my own to sign contracts from $1,000 to $6,000, the contractor accepting them without objection. Valid contracts are frequently made by purchasing agents. An agent might buy five or six cars of copper wire, when the market is low. He signs a contract for certain deliveries of the wire at a certain price, and he will specify in his order (which may not come from the head of a department to him) when the deliveries should be made and at what price; say, 14 cents per pound. In the meantime the market may go up to 20 cents. The contract, however, has been accepted from the purchasing agent who has not the standing of some of the other heads of the departments, as far as a signature goes.

Mr. A. P. Greensfelder. I think the courts would construe that as where a certain amount of authority has been previously exercised, such as the chief engineer awarding contracts, his authority never having been rescinded, his company was liable.

Mr. J. T. Garrett. I can say one thing, that it cost me $1,500 to find out that others beside an officer of the company could sign a contract, and he does not have to be very much of an agent either. The mere fact that he was working for a corporation at that particular time and with the corporation's consent, is sufficient to bind the corporation.

Mr. A. P. Greensfelder. That is, unless you question his right at the time of signing. You probably tacitly agreed that he was a legal agent.

MR. J. T. GARRETT. Well, whether he had our consent at that time or not, I found out that it was binding.

MR. A. P. GREENSFELDER. A great many phases of equity can be mentioned. For instance: Requiring a guarantee from a firm of contractors for work on which the specifications are clear and inspection required, and where one is told when and in what manner to do it.

[NOTE—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

SPECIAL FEATURES OF POWER PLANT EQUIPMENT FOR THE RAILWAY EXCHANGE POWER PLANT.

By Hugo Wurdack, Member of the St. Louis Engineers' Club.

[Read before the Club, January 21, 1914.]

In designing the power plant for the Railway Exchange Building the engineers were limited in space, due to the predetermined location of the Kingston Building, in which basement the power plant is located. The Kingston Building in turn is limited to available real estate, the over-all dimensions of the lot approximately being 60x140 feet.

Inasmuch as the power plant was designed to meet the heating requirement, as well as the light and power requirement, the size of the plant was determined largely by the heating requirements of the Railway Exchange Building, consisting approximately of 15,500,000 cu. ft., and requiring approximately an equivalent of 200,000 sq. ft. of direct radiation.

The coal bunkers, which receive coal from the sidewalk, have a storage capacity approximately of 600 tons, or one week's supply. The coal drops by gravity into an Alvey-Ferguson Bucket Conveyor, and is elevated into steel hoppers mounted on scales constructed in such a manner that the hopper for each boiler is separately mounted. The coal feeds from the hoppers by gravity into four inclined Green Chain Grate Stokers, having an active grate surface of 110 feet each, and each grate serves one Heine Boiler of 5,180 feet heating surface, equipped with middle baffle, so that the flue gases have three horizontal passes through the boilers.

Each boiler is equipped with one Foster Super-heater approximately of 1,000 sq. ft. heating surface. The super-heater is mounted on top of the boiler, in the last pass of the flue gases, and is designed to deliver a super-heat of 50 degrees to steam at a pressure of 225 pounds. A super-heater is mounted on the back or low end of the boiler, and steam is admitted into the super-heater from the back of the boiler through a dry pipe brought from the front or steam space of the boiler along the interior of the drum to an outlet at the back or low end connecting through the drum to the last pass of the super-heater, from which the steam passes through a three pass super-heater, and thence direct to the 750 kw. normal rated turbine through a 5-in. extra heavy steam pipe.

The boiler settings consist of two batteries of two boilers

each with 13-in. side walls and 18-in. division walls built of solid fire brick.

The settings are so designed that each boiler connects direct to a steam turbine immediately adjoining the boiler through 5-in. connections approximately 19 ft. long. These four connections are in turn connected through a cross header consisting of 5-in. pipe. The header is so connected that it can be shut off from either boiler by closing the gate valve.

The boilers are supplied with feed water from a 2,000 h. p. Cochran Heater, which is equipped with a recording flow meter to indicate the pounds of water delivered to the boilers. The heater discharges into a suction of two motor driven Alberger Centrifugal Boiler Feed Pumps of 125 gallons per minute each, and one steam turbine-driven Westinghouse Centrifugal Boiler Feed pump of 250 gallons per minute.

In addition to the regular equipment the boilers are equipped with General Electric Indicating Steam Flow Meters and the turbines are equipped with one General Electric Recording Steam Flow Meter, which can be connected to either turbine.

The live steam main supplying live steam for the building is equipped with a General Electric Indicating, Recording, Integrating Steam Flow Meter.

The chain grates are of the inclined type in order to provide better combustion space, which is desirable for the large overload the grates are called upon to deliver. The grates are equipped with low pressure water backs. The ash falls from the grates into concrete fire brick lined air tight ash pits, from which it is lifted by a vacuum system to an ash tank (7x14x45 ft. high), located in the building, at an elevation about 60 ft. above the street, from whence the ashes fall by gravity into wagons.

The smoke stack is of steel, 9 ft. in diameter and approximately 300 ft. in length. It is lined with asbestos from the street level to an elevation of about 60 feet. The stack is self-supporting, and is braced on the building structure.

The general equipment consists of 3-750 kw. normal rated, 3 phase, 60 cycle, 250 volt, alternating current, turbo-generators. All current is delivered to the machine busses at 250 volt, 3 phase, 3 wire, from which the current for elevators is delivered through 3-300 kw., 3 phase, Y connected auto transformers to 3-300 kw., 250 volt rotary converters, thence to the distributing board of the Railway Exchange Building, which is located in

the power plant building. The current for power is delivered 250 volt, 3 phase, 3 wire.

The lighting service is delivered through 1-1,000 kw., 3 phase, Y connected auto transformer to a 3 phase, 4 wire distribution system of 120 volts from line to neutral distributing panel, which is located in the power plant. All lighting in the Railway Exchange Building being connected on the 3 phase, 4 wire, 60 cycle alternating current lines.

The service rendered by the power plant is protected by a direct connection between the power plant and the main station of the Laclede Gas Light Co., through a sub-station located in the power plant building, from which the entire current is taken during the summer months, and which service is used as a relay or stand-by during the winter.

The exciters consist of one motor-driven 25 kw. capacity, and one 25 kw., 3,600 revolution steam turbo built by the General Electric Company. In addition to these exciters there is a storage battery equipment so arranged that it will automatically cut in, should the exciters for any reason drop the load.

The special features of this plant are:

Ist. The entire fire brick setting of the boilers.

2nd. The method of bringing the steam dry pipe along the drum and out of the lower end of the boiler, direct in the superheater without external piping.

3rd. The small pipe areas, there being nothing larger than a 5-in. pipe on the pressure side.

4th. The vacuum ash handling equipment.

5th. The water and steam flow meters.

6th. The low voltage alternating current generators.

7th. The alternating current, 4 wire distribution for large office and store building.

8th. The location of the engine power plant below the sidewalk level in the business district.

Many of the features that were new at the time this plant was designed, have now come into general use, and are being extensively applied in the power plant construction.

It might be of interest to say that the operating results from this plant have fully met the expectations of the engineers and have justified the careful planning and painstaking attention to detail in the plant construction.

[NOTE.—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

THE VALUATION OF RAILROADS.

Discussion by L. S. Pomeroy, C. E., Member of the Civil Engineers' Society of St. Paul.

[Volume 52, page 121, March, 1914.]

Apropos of Mr. Jonah's presentation of the subject of "The Valuation of Railroads" in the March issue of the Journal, the writer would like to offer a short additional discussion of the subjects of "Multiple Values Applied to Right of Way" and "Depreciation," not because he has anything to add to what has already been said along these lines but to show as appears to his mind, the inconsistency likely to be encountered in the carrying out in specific cases of the principles enunciated by the U. S. Supreme Court in the now famous Minnesota Rate Case, as regards these subjects.

It is noted that Mr. Jonah says on page 129 of his article,—"The recent decision of the Supreme Court is universally regarded as erroneous so far as it related to the Right of Way matters by those having any knowledge of or experience in the purchase of property or Right of Way for railroads. That decision says, "the roads should put in their property at market value."

The writer has been accused of being a bad citizen for voicing a sentiment similar to what Mr. Jonah says above is now the universal opinion of engineers, and it would appear (in the language of the vernacular) to be up to the one making the accusation to refute Mr. Jonah's statement. In that he has not attempted to do so, we of the majority are left to infer that the minority have become convinced that they occupy a position among members of the Engineering Profession so hopelessly small as to render their views negligible.

Along this same line it may be interesting to inquire how the decision of the Court above referred to, is likely to operate in specific cases which have come under the writer's notice.

In the year 1908, he was in the employ of the Minnesota Railroad Commission on the original valuation of Minnesota railway property. It was a part of the work of the Valuation Staff to ascertain the market value of the railroad lands as well as right of way value, which latter term being interpreted was market value with a sufficient multiple applied to provide for severance damages and cost of acquisition, as well as the incre-

ment of value which any property always takes on, when it becomes known that it is needed for railway purposes. Much time was spent by him in compiling irrefutable statistics to prove that on those lines of the Minneapolis, St. Paul & Sault Ste. Marie Railway, recently built and running from Glenwood, Minn., north to the international boundary at Emerson, and from Thief River Falls on this line west to the North Dakota state line near Oslo, Minn., the price actually paid by this company was approximately three times the market value of adjoining lands, and that paid in the city of St. Paul by the same company for land for terminal purposes was about one and three-quarters times its market value.

In the light of the Minnesota Rate Case decision, what value is now to be placed on these lands in any valuation that may be undertaken for rate making purposes? If they are to be inventoried as the court says at a "fair average market value of similar land in the vicinity, without additions by the use of multipliers or otherwise to cover hypothetical outlays" is not this confiscation pure and simple, or in this case since the outlays were not hypothetical but actual, is this a case that the decision does not provide for? It does not appear to the writer that the language of the court is altogether clear as applicable to the case cited.

On the subject of "Depreciation" so much has been written by those better qualified to speak than the writer, that he feels somewhat timid to, in a measure, reiterate what has already been said.

On this point the Supreme Court has said.—"When particular physical items are estimated as worth so much new, if in fact they be depreciated, this amount should be found and allowed for. If this is not done the physical valuation is manifestly incomplete and it must be regarded as incomplete in this case."

It has undoubtedly been noted by the readers of recent engineering literature, that the profession generally takes issue almost to a man, with the doctrine here enunciated, that in any valuation for rate making purposes it is the depreciated value of the plant which must govern, and the present writer is no exception, although as in the case of land values, he has been roundly denounced by some closely connected with the Minnesota Rate Case for his views. His critic's arguments have al-

ways been reduced in the last analysis to the idea briefly expressed as follows:

"Of what use all this discussion as to whether or not depreciation should apply when the Supreme Court has said, that it must."

To such an argument, the writer can think of no more apt rejoinder than in the language of the old saw,—"One may lead a horse to water but one cannot make him drink."

In promulgating the above quoted doctrine with regard to depreciation, the Supreme Court has taken the step of leading the horse to water,—the next question is how is the animal to be made to drink? The impracticability of making him drink at all has been so well brought out in an article published in the December 3, 1913, issue of *Engineering Contracting*, by Mr. H. P. Gillette, that the writer cannot refrain from quoting a paragraph which expresses almost exactly his own ideas, and which had many times been at least verbally expressed by him, before he ever read the article by Mr. Gillette.

"It should be conceded by all, that the justness and reasonableness of rates depends not altogether upon the mere intrinsic or even second-hand value of a property, but also upon its value to the public by reason of use,—therefore if a property is well maintained and serves the public adequately and comfortably, can its value for rate making purposes be affected by the fact that the rails are five years old, or that the cars have been in service for several years? To admit this would be utterly at variance with all logic and reason. For if such were the case, a new rate schedule would of necessity be filed every day, and the passengers traveling between his home and the down-town district would pay a smaller rate of fare each day owing to the fact that the property used in transporting him would be gradually growing older. Thus the absurdity of considering the depreciated value as a basis of rate making is clearly indicated and after the establishment of the fact that a property is in good operating condition, the question of depreciated value may be entirely dismissed."

[NOTE—Further discussion of this paper is invited, to be received by Joseph W. Peters, 3817 Olive Street, St. Louis, for publication in a subsequent number of the JOURNAL.]

Association Engineering Societies

Vol. 52. JANUARY, 1914. No. 1

PROCEEDINGS.

Engineers' Club of St. Louis.

The 744th meeting of the Club was held in the Club Rooms on Wednesday, June 11th, with President Hunter presiding. The total attendance was 52.

The minutes of the 743rd meeting were read and approved.

A letter from the Board of Freeholders was read and ordered published.

Mr. A. F. Krippner. General Manager of the Missouri Gas Heater and Appliance Co., presented an illustrated paper on "Gas for Residence Heating." He showed views of about 20 installations and gave the cost of operation in each case.

Adjournment.

W. W. Horner, *Secretary.*

The 745th meeting of the Club was held in the Club Rooms on Wednesday, September 17, with President Hunter presiding. There were present 40 members and 5 visitors.

The minutes of the 744th meeting were read and approved; the minutes of the 534th and 535th meeting of the Executive Committee were read.

The following recommendation of the Executive Committee was adopted by the Club: "If the Members of the Board of Managers can secure the Secretaryship of the Association to St. Louis, then the Club shall co-operate in the employment of the Secretary by making him also Secretary or Assistant Secretary of the Club, and the Club shall appropriate $50.00 a month as compensation for his work for the Club." After discussion it was ordered that the Executive Committee and the St. Louis Members of the Board of Managers proceed to select a suitable candidate for Secretary of the Association and to place him in nomination.

The following amendment to the By-Laws was adopted:

"1. Change the numbers of Sections 4 to 14, inclusive, to 5 to 15, respectively.

2. Insert a new Section, to be known as:

Section 4. Secretary—The Secretary shall either be nominated and elected in the manner specified in Sections 12 and 13 of these By-Laws, in which case he must be a qualified resident member; or, if the Club should so decide by a majority vote at any regular meeting, the Secretary may be appointed by the Executive Committee for a period of one fiscal year, and at a salary to be fixed by the Club upon the recommendation of the Executive Committee, in which case the Secretary need not necessarily be a member of the Club."

The obituary of George Daniel Rosenthal was read. It was ordered spread on the minutes of the Club and printed in the Journal.

Mr. Edw. E. Wall presented an exceptionally interesting paper on "The Status of the Engineer."

Adjourned, 10 p. m.

W. W. Horner, *Secretary.*

The 746th meeting of the Club was held in the Club Rooms on Wednesday, Oct. 1st, at 8:15 p. m., President Hunter presiding. There were present 45 members and 9 visitors. The minutes of the 745th meeting of the Club were read and approved.

Following the reading of letters from Mr. Brooks in regard to the Secretaryship of the Association, Mr. Holman spoke at length warning the Club against assuming responsibility for the publication of the Journal and suggesting that the Club withdraw from the Association before it was left with the entire burden. On motion of Mr. Holman, seconded by Mr. Langsdorf and amended, the matter was made a special order of business for the meeting of Nov. 15th, and the Secretary was instructed to correspond with the societies remaining in the Association to determine whether they intend to remain in the Association when they know that Boston, Detroit and Oregon have voted to withdraw.

Prof. J. L. Van Ornum presented his paper on "The Effect of Saturation on the Strength of Concrete," and Mr. Montgomery Schuyler presented a paper on "Compression Tests of Concrete." Both papers were discussed at length.

Adjourned at 10:30 p. m.

W. W. Horner, *Secretary.*

The 747th meeting of the Club was held in the Club Rooms on Wednesday, Oct. 15th, at 8:15 p. m. There were present 31 members and 21 visitors.

This was a Joint Meeting with the Local Section of the A. S. M. E. President Hunter called on Chairman Ohle, of the A. S. M. E., to preside.

Mr. L. A. Day, Chief Mechanical Engineer of the Water Dept., presented a paper on "The New Turbine Pumps at the Chain of Rocks."

Adjourned 10:15 p. m.

W. W. HORNER, *Secretary.*

The 748th meeting of the Club was held in the Club Rooms on Wednesday, Oct. 29, at 8:30 p. m. The total attendance was 82. This was a Joint Meeting with the St. Louis members of the American Society of Civil Engineers. President Hunter called on Mr. Purdon to preside. Mr. F. G. Jonah, Chief Engineer of the Frisco, presented a paper on "The Valuation of Railroads." The subject was discussed informally by Messrs. Allison, Hobein, Krausman, Brown, Hubbard, Phillips, Pfeifer, Coburn, Toensfeldt, Bryan, Fisk and Henry. At the conclusion a vote of thanks was tendered Mr. Jonah for the excellent presentation of the subject.

Adjourned 10:30 p. m.

W. W. HORNER, *Secretary.*

The 749th meeting of the Club was held in the Club Rooms on Wednesday, Nov. 5th, at 8:15 p. m., President Hunter presiding. There were present 62 members and 18 visitors.

The minutes of the 746th, 747th and 748th meetings were approved, and the minutes of the 567th meeting of the Executive Committee were read.

The Secretary read a letter from the Secretary of the Mississippi River Levee Association asking the Club's endorsement of the Mississippi River Commission plans for the levee of the lower Mississippi. On motion of Mr. Woermann, the President was authorized to appoint a committee to investigate and to report to the Club at its next meeting, with recommendations.

The Nominating Committee for officers for 1914 was elected as follows: Richard Morey, Chairman; W. S. Mitchell, P. M. Bruner, C. M. Woodward, C. M. Talbert.

In accordance with Mr. Holman's motion at the 546th meeting the Secretary presented a file of correspondence with the societies remaining in the Association, in regard to their attitude toward the Association. Mr. Woermann also gave information on the subject. On motion of Mr. Flad, seconded by Mr. Woermann, it was voted that "It is the sense of this meeting that we retain membership in the Association, and proceed with our efforts to re-organize and rehabilitate the Association of Engineering Societies."

Mr. Bryan, for the Board of Managers, announced that Mr. Gardner S. Williams had been elected Chairman and Mr. Joseph W. Peters, Secretary of the Association for the next two years.

Mr. Spoehrer made an announcement of the trip to the Mississippi River Power Co.'s sub-station and to the Fulton Iron Works on Saturday, Nov. 8th; and a vote of thanks was extended to the Fruin & Colnon Construction Co., to Water Commissioner Wall and to Harbor Commis-

sioner Hellmich for the courtesies received on the excursion on Nov. 1st

In the absence of Mr. C. D. Purdon, Mr. V. K. Hendricks read Mr Purdon's paper on "Railroading Sixty Years Ago." Mr. Purton quoted at length from reports to the War Department in 1850-1860 on practice in railroad construction and operation of that time and made some comparisons with modern practice.

Dr. C. M. Woodward gave an informal talk on the "Failure of Rails Under Fast Trains." He analyzed some of the forces acting on rails under fast trains (especially with reference to the entry of the locomotive onto a curve) and presented some figures on their magnitude. This paper provoked a lively discussion on the mathematical and the practical side of the question.

Adjourned 11 p. m.

W. W. Horner, *Secretary.*

The 750th meeting of the Club was held in the Club Rooms, Wednesday, Nov. 12th, at 8:15 p. m., as a Joint Meeting with the St. Louis Section of the A. I. E. E. The total attendance was 77.

President Hunter called upon Mr. F. J. Bullivant, Chairman of the St. Louis Section of the A. I. E. E., to preside.

Prof. Morgan Brooks presented a paper on "The Effective Illumination of Interiors."

Adjournment.

W. W. Horner, *Secretary.*

The 751st meeting of the Club was held in the Club Rooms on Wednesday, Nov. 19th, at 8:15 p. m. This was a Joint Meeting with the St. Louis Section of the A. S. E. C. There were present 27 members and 16 visitors. President Hunter called the meeting to order.

The Secretary stated that Mr. Walter Ashton had presented his resignation as Member of the Board of Managers, and that the Executive Committee had accepted the resignation. The President called for nominations for Member of the Board to fill the vacancy. Mr. J. W. Woermann was nominated by Mr. Greensfelder and seconded by Mr. Garrett. On motion of Mr. Bryan the nominations were closed and the Secretary cast the ballot of the Club for Mr. Woermann.

The report of the Nominating Committee as given herein was received and ordered printed.

On motion of Mr. Toensfeldt, amended by Mr. Greensfelder, the recommendation of the Committee in the matter of amending Section 11 of the By-Laws was made a special order of business for the next meeting.

On motion of Mr. Morey the Secretary was instructed to place the nominees for Members of the Board of Managers on the Ballot as candidates for a term of two years.

A letter from the Business Men's League inviting the members and their friends to inspect a model of the Panama Canal now on exhibition in the League offices, was read.

President Hunter called on Mr. Greensfelder, of the A. S. E. C., to preside. Mr. A. A. Aegerter gave an informal talk, giving an outline of

the Law of Contracts, and presenting his views on its application to some examples.

Adjournment.

W. W. HORNER, *Secretary.*

The 752nd meeting of the Club was held in the Club Rooms, Wednesday, Nov. 26th, at 8:30 p. m., President Hunter presiding. There were present 60 members and 20 visitors.

Mr. E. R. Kinsey made a statement of the more recent developments in the "Municipal Bridge Question," and informed the members fully of the problem as now before the City Administration.

Additional information of special interest was given by Mr. H. B. Taussig and a general discussion followed in which about thirty members participated.

A vote of thanks was tendered Mr. Kinsey on adjournment.

Adjourned 10:30 p. m.

W. W. HORNER, *Secretary.*

Montana Society of Engineers.

BUTTE, MONT., NOVEMBER 10, 1913.—The November meeting was called to order by Prof. C. H. Bowman, acting as chairman pro tem. Members present: E. H. Wilson, McMahon, Bowman, Goodale, F. T. Donahoe, Bard, Moore, McArthur, Whyte and Simons. Minutes of last meeting approved. Bowman and Ingalsbe, members of committee appointed to attend National Conservation Congress, declined for reason of pressing business. Committee on the matter of withdrawal from the Association of Engineering Societies failed to report for reason of the absence of Chairman Barker. The following committee, Messrs. Gillie, Dunshee and Sales, was appointed to prepare resolutions and sketch for journal on death of the late John C. Adams. The topic for consideration, "The Mississippi Floods and Their Prevention," proved an interesting subject and was discussed at length by E. H. Wilson, whose experience as a member of the U. S. Engineers Commission having the work in charge in former years, afforded first-hand knowledge of the subject.

Adjournment.

CLINTON H. MOORE, *Secretary.*

Utah Society of Engineers.

The regular meeting of the Society was held Friday, November 21st, at 8 p. m., in the "Call Room" of the Salt Lake Stock & Mining Exchange. About 85 persons were present.

In the absence of President Peters, Mr. T. H. Beckstrand, First Vice-President, presided.

Minutes of the October meeting were read and approved.

The following persons were elected by written ballot as members of the Society:

John L. Mess, Engineer, Utah Power & Light Co., Salt Lake City, Utah.

David J. Kelly, Metallurgist, Kelly Filter Press Co., Salt Lake City, Utah.

Geo. T. Hansen, Distriet Manager, Allis-Chalmers Mfg. Co., Salt Lake City, Utah.

Elmer E. Jaeob, Engineer, Wheelwright Construction Co., Payson, Utah.

There being no further business before the Society, the Chairman introduced Mr. Sylvester Q. Cannon, City Engineer of Salt Lake City, who gave an illustrated address on the subjeet "Water Supply and Distributing System of Salt Lake City."

The address was exceptionally interesting to all present, being a complete resume of the history, physical condition and present and future possibilities of the water supply of the city. Following Mr. Cannon's address, Mr. Herman Harms, City and State Chemist, read a paper on the analysis and various properties of our present water supply, giving also results of various tests made of the water from the different streams.

Following the papers, a lengthy and interesting discussion of the many features brought out by the speakers was participated in by Messrs. Doremus, Brown, Sholey, Cannon, Harms, Wade, Vadner, Lyman and many others.

Mr. Lyman suggested that the Society pass a resolution addressed to the City Commissioner that all available water adjacent to the city be acquired. The Chairman suggested that the question of such a resolution be postponed until the members should have had time to read and study the papers delivered at this meeting.

It is expected that the complete address and paper will be published in an early issue of the Association Journal.

Adjourned.

Fred D. Ulmer, *Secretary.*

Association Engineering Societies

Vol. 52. **MARCH, 1914.** No. 3

PROCEEDINGS.

Civil Engineers' Society of St. Paul.

St. Paul, Minn., January 12, 1914.

The thirty-first annual meeting of the Civil Engineers' Society of St. Paul was held in the Society Rooms, Room 7, Old Capitol, January 12, 1914. President J. H. Armstrong in the chair. There were present thirty-two members.

Minutes of the last meeting of the Society were read and approved.

Moved, seconded, and carried that Mr. G. O. House be reinstated as a full member of the Society without payment of initiation fee.

Moved, seconded, and carried that the Secretary cast the unanimous ballot of the Society for the election of the following candidates to full membership in the Society: W. E. Smith, City Engineer's Office, St. Paul; George M. Shepard, 1000 Germania Bldg., St. Paul; G. F. Elstone, 1141 Pacific Ave., St. Paul; W. B. Irwin, 1208 Grand Ave., St. Paul; H. Rettinghouse, 35 North Grotto St., St. Paul.

Annual reports, appended hereto, were read by J. H. Armstrong, President; H. A. Lyon, Acting Secretary; Oscar Palmer, Treasurer; Oscar Palmer, Librarian.

Moved, seconded, and carried that the reports of the officers be accepted and that they be made a part of the minutes of this meeting, and that they be printed in the Association Journal.

Report of the Entertainment Committee, appended hereto, was read by Hr. Herrold, Chairman.

Moved by Mr. Wolff, seconded and carried that the report of the Entertainment Committee be accepted and that a vote of thanks be extended to the Committee in appreciation of their energetic and efficient work.

Report (verbal) by Mr. Wolff, Representative of this Society on the Board of Managers of the Association of Engineering Societies on Association Affairs.

Report by Mr. Druar, Chairman of the Membership Committee on the work accomplished during the year by that Committee.

Moved by Mr. Toltz, seconded and carried that a vote of thanks be extended to all members of the Membership Committee.

Election of officers for the ensuing year announced by President Armstrong as the next order of business.

Moved by Mr. Rathjens, and seconded, that names for officers to be elected be presented by oral nomination.

Amendment offered by Mr. Jurgensen, and seconded, that informal written ballot be taken before presentation of oral nominations. Amendment submitted to vote and lost.

Original motion submitted to vote and lost.

Election of officers by written ballot then proceeded:

President: Mr. Toltz, 29; Mr. Brink, 1; Mr. Herrod, 1. Total, 31.

Moved by Mr. Wolff, seconded and carried, that the informal ballot be declared formal, and that the Secretary cast the ballot of the Society for Mr. Toltz for President.

Vice-President: Mr. Meyer, 19; Mr. Druar, 9; Mr. Herrold, 1; Mr. Hogeland, 1; Mr. Carroll, 1; Mr. Rathjens, 1. Total, 32.

Moved by Mr. Rathjens, seconded, and carried, that the informal ballot be declared formal, and that the Secretary cast the ballot of the Society for Mr. Meyer for Vice-President.

Secretary: Mr. Dugan, 24; Mr. Rathjens, 2; Mr. Brink, 1; Mr. Lyons, 1; Mr. Herrold, 2; Mr. Van Ornum, 1. Total, 31.

Moved by Mr. Druar, seconded, and carried, that the informal ballot be declared formal, and that the Secretary cast the ballot of the Society for Mr. Dugan for Secretary.

Treasurer: Mr. Brink, 21; Mr. Wolff, 1; Mr. Armstrong, 1; Mr. Danforth, 2; Mr. Palmer, 1; Mr. Rathjens, 1; Mr. Fowble, 3. Total, 30.

Moved by Mr. Danforth, seconded, and carried, that the informal ballot be declared formal, and that the Secretary cast the ballot of the Society for Mr. Brink for Treasurer.

Librarian: Mr. Palmer, 31. Unanimous.

Chair then taken by Mr. Toltz, the newly elected President.

Retiring President Armstrong was tendered a unanimous vote of thanks by the Society for his work of the past year.

Moved by Mr. Herrold, seconded, and carried that all special committees hold over until their reports are made.

Moved by Mr. Palmer, and seconded, that the Constitution of the Society be amended by striking out of Article 17 all of the last sentence of said Article, relating to dues of resident members, and inserting in place thereof the following:

"The regular annual dues for resident membership shall include subscription to the Journal of the Association of Engineering Societies. It shall be payable in two equal semi-annual payments in January and July, and shall be for members, $7.50 per year, and for Junior members, $5.50 per year, beginning with January, 1914."

Moved by Mr. Dugan, seconded, and carried, that the preceding motion relating to Journal subscriptions be laid on the table until after

discussion and decision in the matter of our remaining in or withdrawing from the Association of Engineering Societies.

Moved by Mr. Herrold, and seconded, that the St. Paul Society withdraw from the Association of Engineering Societies.

Amendment offered by Mr. Armstrong, and seconded, that the motion be laid on the table until the next regular meeting and that the Secretary present the question to all members and obtain their vote on the matter by letter. The result of such vote to be reported by the Secretary at the next regular meeting. General discussion followed. Amendment submitted to vote and lost.

Amendment offered by Mr. Starkey that this Society remain in the Association for at least one more year to await developments resultant to the recent changes in the Association. Amendment submitted to vote and carried. Yea, 22. No, 8.

Original motion by Mr. Herrold nullified by adoption of amendment.

Motion by Mr. Palmer, relative to Journal subscriptions to be made compulsory by Constitutional amendment, taken from table, submitted to vote, and lost.

New club rooms were then discussed.

Club Room Committee appointed by the Chair with instructions to make investigation and report: Mr. Carroll, Mr. King, Mr. Brink.

Moved by Mr. Druar, seconded, and carried, that the Treasurer send a floral piece with letter of sympathy to the funeral of Mrs. Forbes.

Adjournment.

E. J. Dugan, *Secretary*.

St. Paul, Minn., January 12, 1914.

The Civil Engineers' Society of St. Paul,

Gentlemen:

It gives me great pleasure to be able to announce that your Society has made rapid progress along all lines during the past year. As will be shown by the Secretary's report, we have now a membership of eighty-seven resident members and forty-three non-resident members, making a total of one hundred and thirty in all against one hundred and ten on January 1, 1913. Likewise, the Treasurer's report will show we are financially in good condition.

This splendid showing is altogether due to the work of your well-organized committees. The Committee of Public Affairs with Mr. Meyer as chairman, the Committee on Membership with Mr. Druar as chairman and the Entertainment Committee with Mr. Herrold as chairman, have certainly earned your thanks for the past year's work. They are live wires and the right men in the right place.

There are a few matters that I would like to call your attention to, —one is that at our Engineers' meetings a little more care should be taken in the conduct of our business affairs. If an engineer is anything he is supposed to be a careful business man and in the meetings should conduct himself as such.

I will further suggest and recommend that no resolution be introduced and passed by a small number of members which changes any by-law or custom long enough established to become a by-law, without first notifying the absent members that a vote will be taken at the next regular meeting to change said by-law or custom. Because a member is absent is no reason why he should lose his vote,—in fact, some of our old members who seldom attend the meetings are men who are an honor to this club and should be notified by postal card of any change of importance.

I would, likewise, advise that our Society take an active part in matters which concern engineers only; any deviation from this rule will eventually lessen our influence with the public, and in nine cases out of ten, public opinion controls. There is no reason why the Civil Engineers' Club of St. Paul with the present standing and the number of active energetic members taking an interest in every move that we make should not be the best organized and equipped Club in the Northwest.

I wish to thank you, Gentlemen, for your support and goodwill during my term of office and to assure you that the progress and welfare of the good old St. Paul Engineers' Society will receive my hearty support and aid at any and all time.

Yours truly,

J. H. Armstrong, *President.*

Annual Report of the Secretary for the Year 1913.

At the last election Mr. L. S. Pomeroy was re-elected Secretary of this Society and acted in that capacity until the summer months when his business took him out of the city.

On October 25, the present incumbent was appointed by the chair to fill out the balance of the year, and in taking up another's work has done everything possible to keep the affairs of the Society in running order. He wishes to express his thanks to Mr. O. Palmer for much assistance in this work.

As Acting Secretary of the Civil Engineers' Society of St. Paul I have the honor to submit the following report of this Society for the year 1913:

On January 13 our membership consisted of 68 resident full members, 2 resident Junior members, 38 non-resident full members, and 2 non-resident Junior members, making a total of 110 members. At present we have a membership of 85 resident full members, 2 resident Junior members, 42 non-resident full members and 1 non-resident Junior member, making a total membership of 130,—a gain of 20 members over the previous year.

During the same period we have lost 3 members who were dropped from the rolls for non-payment of dues,—1 resignation, Mr. Robert Follansbee of the U. S. Geological Survey, who was transferred to Denver,

and 1 member, Mr. E. C. Hollidge, Div. Engineer, Soo Ry., of Superior, Wis., who responded to the call of the Great Beyond, January 20, 1913.

During the year of 1913, the Society held eight regular and three special meetings, at which the following papers were read before and discussed by the Society:

"Kinks in Structural Drawing and Shop Details," by Mr. E. A Goetz.

"The Panama Canal," illustrated by personal views, by Mr. O Crosby.

"Asphaltic Concrete as a Paving Material for Residence Streets," by Mr. Linn White of Chicago.

"Lift Bridges," illustrated, by Mr. J. L. Harrington of Kansas City.

"American Metal Mining," by Prof. Ervin McCullough of the State University.

"Economical Design of Factory Buildings," from the standpoint of the Industrial Engineer, by Mr. W. E. King.

"Incinerators for the Disposal of Municipal Waste," by Mr. E. N. Stacey, illustrated by lantern slides.

"Photography for Engineers," by Mr. H. LeRoy Brink.

These papers were very beneficial and interesting and it is the opinion of the Acting Secretary that in the future, copies of all papers read before the Society should be embodied and made a part of the minutes of the meeting, so that a permanent record would be retained by the Society.

Attendance.

The attendance at the regular and special meetings has been steadily on the increase and shows a growing interest is being taken in the affairs of the Society. During the past year we have held eight regular monthly and three special meetings,—the average attendance being 22 members and 24 guests. The smallest attendance was at the April meeting when but 14 members were present. The largest meeting, the March regular monthly meeting, 33 members and 140 guests were present to listen to Mr. Crosby's lecture on the "Panama Canal."

Too great emphasis cannot be laid on the interest and pleasure of the summer outings, and the "get-together" spirit of these occasions is a means of the members becoming better acquainted and arousing interest in the Society.

The Society took four outings during the past summer as follows:

First—July 19—Twenty-five members in five automobiles made a visit to the Gravel Washing Plant of Butler Bros. at Randolph, and the new dam and power plant of the Consumers Power Co. at Cannon Falls. Our picnic luncheon at noon was enlivened at its close by the appearance of a German woman with a "big stick," notifying the innocent Society members they were guilty of trespassing. Her warlike manner was soothed by the tender of a two dollar bill through the efforts of Messrs. Meyer and Herrold. Dinner was served at Hastings on the return trip.

Second—August 9—Nine members of the Society accepted the in-

vitation of the Red Wing Sewer Pipe Co. to visit their plant at Hopkins. The trip was made by trolley and the expenses paid by the Company.

Third—August 23—Thirty-five members and their ladies took a trolley trip to the dam and power plant of the Consumers Power Co. under construction at Coon Creek.

Fourth—October 4—Twelve automobiles and forty-eight people, nearly half of whom were ladies, took a trip over the water-shed of the St. Paul Water Works System. Luncheon was served in the pumping station at Centerville after which visits were made to Pleasant Lake, and the pumping stations at Lake Vadnais and McCarron's Lake.

The Entertainment Committee deserves the hearty thanks of the Society for these outings and it is to be hoped that more such trips may be made during the summer months. It would be a good move to arrange that in the future, accommodations be made for our ladies on all our summer outings.

The Monday noon luncheons inaugurated by the Entertainment Committee have proven a success from every standpoint and again we should thank our Committee for this innovation. The attendance at the luncheons has averaged twenty-two members,—the smallest number present being nine members,—the largest number thirty-three members.

Our appreciation should also be shown to the members of the Membership Committee as well as to all others who have helped in the rapid growth of the Society.

In fact we should appreciate the work done by all the committees as they have shown a great deal of time and careful study were given to their various details.

Two of the largest societies, those of Boston and Detroit, have withdrawn from the Association of Engineering Societies and the Secretaryship has been taken up by Mr. J. W. Peters of the St. Louis Society.

The year 1913 has proven one of the best in the annals of this Society and it is to be hoped that each succeeding year will mark a greater stride forward in efficiency, membership and benefit to the Society and the City of St Paul.

H. A. Lyon, *Acting Secretary.*

Treasurer's Report for 1913.

RECEIPTS

Cash on hand January 13, 1913		$ 84.88
Collections:		
Dues for years previous to 1913	$ 80.50	
Dues for 1913	406.60	
Journal subscription	110.75	
Extra copies of Journal sold	.40	
Initiation fees	124.00	
Accounts overpaid	5.35	
Badges sold to members	18.00	
Banquets, subscriptions and tickets	371.50	
Old bookcases sold	8.00	
Donation pennant	3.50	
Profits from excursions	13.95	1.142.55
Total receipts		$1,227.43

DISBURSEMENTS

For Assessments, Journal Ass'n Eng. Societies	$171.63	
For subscriptions to Eng. Periodicals	28.00	
For printing and stationery	85.85	
For binding	29.75	
For lectures (all expenses)	47.50	
For entertainment, inc. banquet	334.32	
For stenographic services	65.70	
For postage	69.94	
For janitor and labor for Club room	52.00	
For insurance on Library	12.00	
For new books	51.65	
For new bookcases	81.00	
For blueprinting	22.22	
For telephone calling	19.50	
For Society pennants	7.00	
For express charges	1.00	$1,079.06
Balance on hand		$ 148.37

RESOURCES

Deposit in First National Bank	$ 148.37
Ledger accounts due the Society	204.50
Gold badges on hand—3, at $1.50	4.50
Total resources	$ 357.37

LIABILITIES

None	$ 00.00
Net resources	$ 357.37

Dated January 12, 1914.

Respectfully submitted,

OSCAR PALMER, *Treasurer.*

Annual Report of the Librarian for the Year Ending January 12, 1914.

Increases for 1913

Text books	10
Periodicals bound	17
Reports	21
Index periodicals	1
Technical Dictionary	1
Total increase	50

Totals

Text books on hand	206
Periodicals bound	349
Reports and miscellaneous	428
Total bound volumes	983

Bookcases on Hand

Old style cases—2, value	$ 50.00
Sectional cases—50 units, 10 bases, 10 tops—value	196.00
Magazine rack	7.00
	$ 253.00
Value of 983 volumes, at $5.00	4,915.00
Total value of Library	$5,168.00

We now have on our reading table the following periodicals:

Engineering News, Engineering Record, Railroad Age Gazette, Municipal Journal, Good Roads, Concrete Cement Age, Journal of the Association of Engineering Societies, Transactions of the American Society, Transactions of the Society of Western Pennsylvania, Journal of the Western Railway Club, Transactions of the Cleveland Society, Professional Memoirs, Panama Canal Record, Transactions Nova Scotian Institute of Science, Bulletins University of Illinois, Idaho Society Journal, Utah Society Journal, Water Power Chronicle, Western Society of Civil Engineers.

Also a large number of reports and bulletins on engineering subjects.

Oscar Palmer, *Librarian.*

Dated January 12, 1914.

St. Paul, Minn., January 12, 1914.

To the President, Civil Engineers' Society of St. Paul:

Your Entertainment Committee submit herewith their report for the year 1913.

During the year the following lectures or papers were arranged for and delivered at the evening meetings of the Society:

Edgar A. Goetz, member Civil Engineers' Society of St. Paul. Paper on "Kinks on Structural Drawings," given February 10.

Oliver Crosby, member Civil Engineers' Society of St. Paul. Illustrated descriptive lecture on the Panama Canal, given March 10.

Linn White, member Western Society of Engineers. Chief Engineer of South Park Commission, Chicago. Paper on "Asphalt Concrete as a Paving Material for Residence Streets, Suburban Districts and Park Boulevards." Illustrated. Given April 7.

John Lyle Harrington of Waddell & Harrington, Consulting Engineers, Kansas City. Lecture on "Vertical Lift Bridges," their design and construction. Given at an extra meeting April 19.

Ervin W. McCullough, Department of Mining, State University, Minnesota. An illustrated paper on "Metal Mining." Given May 12.

W. E. King, member Civil Engineers' Society of St. Paul. Paper on the "Economical Design of Factory Buildings." Given October 13.

E. N. Stacey, member American Society Mechanical Engineers. An illustrated descriptive lecture on "Incinerators for the Disposal of Municipal Waste." Given November 10.

H. LeRoy Brink, member Civil Engineers' Society of St. Paul. Paper on "Photography and Its Uses for Engineers." Given December 8.

During the summer vacation the following trips were arranged for:

July 12. An automobile trip to the Gravel Washing Plant at Randolph, Minnesota, and the Dam and Hydro-Electric Plant at Cannon Falls.

August 23. Coon Creek Dam and Hydro-Electric Plant near Anoka. The trip was made on a McKeon Motor Car furnished by the Minneapolis & Northern Railway and run special.

October 4. Automobile trip over the St. Paul Water-Shed and Pumping Station with lunch at Centerville.

As a means of promoting the social life and good-fellowship of the members, a Monday noon luncheon was inaugurated by the Committee which has proved to be very successful. At these luncheons the following fifteen minute talks have been given:

P. S. Coyne of Philadelphia. "Asphalt for Paving Purposes."

Max Toltz, Member. "Description of His Trip to Panama."

Arthur White of Toronto. "The International Joint Commission and Their Work."

Adolph Meyer, Member. "Engineering Problems of the Rainy Lake Drainage Area."

John W. Bennett, "Town and City Management as a Field for Engineers."

W. L. Van Ornum, Member. "The Necessity for a Testing Laboratory."

J. J. Ermatinger, Efficiency Bureau, "Municipal Efficiency."

W. H. Handy, City Comptroller, "Municipal Finances."

C. E. Cooley, Chief Engineer State Highway Commission, "The Working of the Elwell Highway Law."

J. H. Mullen, Member. "The work done by the State Highway Commission during the year."

Carl Nagle, Member. "Bridge work done by the State Highway Commission."

H. H. Burgess, Member. "Reinforced Concrete Construction."

J. A. Childs, Member. "The work of the Engineering Department of the State Board of Health."

In arranging for papers and lectures some papers were promised the Committee, which, for various reasons, were not read this year. These papers are "good prospects" and are referred to the incoming Committee. They are as follows:

"Our New Union Depot." By Ralph Budd, Member. Chief Engineer of the Great Northern Railway.

"Good Roads as seen by himself in Europe." Oliver Crosby, Member.

"The Detroit Tunnel." By William Butler. An illustrated paper, which can be arranged for, through H. H. Burgess, member.

"St. Paul Water Works." By Roscoe Smith, Member. Engineer of the Water Board.

A joint paper by Mr. Wolff and Mr. Meyer, members. Subject not yet announced.

John H. Rich, a Red Wing banker and member of the Mississippi River Improvement Association. A paper on the "Necessity of Improving the Mississipppi River.

The Committee wish to extend their thanks to the members of the Society for their support in all that they have attempted to do. The attendance at the lectures has been the largest ever known in the history of the Society and the summer trips were very pleasurable outings in which the members showed great interest. A special vote of thanks should be given those members who so kindly furnished automobiles.

The Monday noon luncheons have been the means of bringing together members and of increasing their acquaintance under conditions overflowing with good fellowship. From the steadily increasing attendance they are viewed with great favor by the members.

Your Committee is now preparing for the annual banquet on January 28. At their first meeting they went over the expenses for the banquet last year and found that the actual cost of the dinner, entertainment, flowers, programs and incidentals, amounted to $2.57 per plate. After carefully considering the matter it was decided to make a charge of $2.00 per plate, for all members and their guests—honorary guests to be entered free, and any excess of expense over the $2.00 per plate to be paid from the Treasury of the Society. The Committee trusts that this action meets the approval of the members.

(Signed)

Committee:
George H. Herrold, Chairman,
George W. Rathjens,
H. LeRoy Brink,
William S. Batson,
James D. DuShane,
W. L. Van Ornum,
Parker Simons,

Louisiana Engineering Society.

Annual Meeting of the Society, January 10, 1914.

The meeting was called to order with President Shaw in the chair, and 23 members and guests present.

The minutes of the previous meeting were read and approved.

A communication from the American Wood Preservers' Association was read.

The annual reports of the Secretary and Board of Directors were read and accepted.

Three tellers were appointed to open ballots for officers and their report was as follows:

There were 51 formal ballots and 15 informal ballots cast. As a result the following officers were elected:

President, Wm. H. Williams.

Vice-President, Ole K. Olsen.

Secretary, James M. Robert.

Treasurer, E. H. Coleman.

Member of Board of Direction, W. B. Gregory.

The report of the Treasurer was read and accepted.

President Williams was then escorted to the chair.

There being no further business the meeting adjourned to the annual banquet, which was thoroughly enjoyed by all present.

Jas. M. Robert, *Secretary.*

Regular Meeting of the Society, February 9, 1914.

The meeting was called to order with President Williams in the chair and 29 members and guests present.

The minutes of the previous meeting were read and approved.

The report of the Banquet Committee was read and ordered filed.

The Technical exercises of the evening were next in order. Professor Gregory delivered a very interesting lecture on "Some Applications of Kutter's Formula to Low Velocities and Small Slopes." After some little discussion of this paper the meeting adjourned to the usual collation.

Jas. M. Robert, *Secretary.*

Utah Society of Engineers.

The regular meeting of the Society was held Friday, December 19, 1913, at 8:00 p. m. in the "Call Room" of the Salt Lake Stock & Mining Exchange. About 50 persons present.

Minutes of the November meeting were read and approved.

The President advised that the Executive Committee had decided that it was advisable to continue as member of the Association of En-

gineering Societies, and also that the offer of the Consolidated Music Company for use of hall had been accepted, and that the January meeting would be held at that place, vacating the room at the Mining Exchange about January 1st.

The Program Committee reported that arrangements were nearly completed for papers and speakers for the rest of this year's meetings.

The following persons were elected by written ballot for membership in the Society:

Resident Members: Frank Winder Moore, Architect, Salt Lake City, Utah.

Joseph H. Felt, Mining Engineer, with City Engineer, Salt Lake City, Utah.

Richard C. Towler, Civil Engineer, with Progress Company, Murray, Utah.

Non-Resident Member: Alex V. Jensen, Superintendent, Union Portland Cement Co., Devils Slide, Utah.

There being no further business before the Society, Mr. E. R. Morgan, Engineer, State Road Commission, was introduced and gave an interesting address on the subject, "Road Problems in Utah." The speaker brought out by illustration and maps, the various requirements of good roads, also showing the progress being made in various parts of our State in the construction of different types of roads.

Professor Lyman, of the University of Utah, and also a member of the Utah Road Commission, followed with remarks covering the evolution of the various types of roads from earth to concrete and other types of permanent roads, giving reasons as to when advisable to construct the different types, also touched on the question of issuing bonds for road construction.

Mr. A. E. Fox, of the Portland Cement Co. of Utah, reviewed the construction of concrete roads with especial reference to road being constructed in Davis County, Utah. He called attention to the various causes of failures of concrete roads, both in design and construction.

Following the addresses, a spirited and interesting discussion was participated in by Messrs. Harms, Dalton, Howard, L. Wilson, Sheley, Ullrich, Beckstrand and many others.

Mr. Howard spoke about use of oil for roads in this district, and Mr. Strange about Bithulitic paving.

Adjourned.

FRED D. ULMER, *Secretary.*

Association of Engineering Societies

Vol. 52. APRIL, 1914. No. 4.

PROCEEDINGS.

Utah Society of Engineers.

The regular meeting of the Society was held at our new headquarters, The Consolidated Music Hall, on Friday, January 16, 1914, at 8:15 p. m. Amout thirty members and visitors present.

The Programme Committee reported progress on arrangement for papers for the ensuing meetings for this season, stating that some details were still to be arranged for both the April and June meetings.

Mr. Francis M. Lyman, Jr., Civil Engineer of Salt Lake City, was elected by written ballot as a Resident Member of the Society.

No further business being before the meeting, the President introduced Mr. J. B. Scholefield, a chartered public accountant of this city, who read a very interesting and instructive paper on the subject, "Engineering and Accounting—their relation, with special reference to public utilities."

Mr. Scholefield's paper paid particular attention to the growing necessity in the bringing together of the engineer and the accountant and also as to proper methods of providing for depreciation and renewal of plants, etc.

On account of an unavoidable absence from the city, Mr. A. M. Nelson was unable to address the Society on the subject, "Physical Valuation of Railroads."

Mr. Scholefield's paper was productive of an interesting discussion participated in by nearly every one present.

Adjourned.

Fred D. Ulmer, *Secretary.*

The regular meeting of the Society was held Friday, February 20th, at headquarters, the Consolidated Music Hall, at 8 p. m. About one hundred members and visitors present.

Meeting was called to order by President Peters.

Complying with Section 1, Article VI, of the Constitution, the Executive Committee announced the names of the following as members

of the Nominating Committee to select candidates for officers for the ensuing year: Messrs. J. F. Merrill, D. H. Blossom, J. H. Tempest, Jr., A. C. Watts and F. W. Moore.

President Peters announced that the March meeting would be held at the Telephone Company's building on State Street and that the ladies and friends of the members were cordially invited to attend.

The following persons were elected by written ballot as members of the Society:

Resident Members—E. C. La Rue, Hydraulic Engineer, U. S. Geological Survey; Elmer A. Porter, District Engineer, U. S. Geological Survey; Joseph H. Jenson, Construction Engineer, State Board of Land Commissioners; Freeman Tanner, Field Engineer, State Board of Land Commissioners; Charles P. Brooks, Civil and Mining Engineer; Walter R. Armstrong, Asst. Genl. Mgr. and Chief Engr., Salt Lake & Utah Railway Co.; W. W. Gardner, Engineer, State Road Commission; E. R. Morgan, State Road Engineer; James W. Wade, Consulting and Mining Engineer.

Resident Junior—A. E. Christensen, Draftsman, Utah State Road Commission.

Associate Member—Herbert J. Blake, Chief Draftsman, Inter-Urban Construction Co.

All of Salt Lake City, Utah.

There being no further business, the President introduced Mr. L. O. Howard, Associate Editor of the *Mining Review,* who read a paper on the subject, "The Development of Our Radium Bearing Ores."

Mr. Howard's paper proved very interesting to all present, as he brought out many facts concerning the value and the difficulties of mining of the radium ores. During his address he showed samples of the various formations containing the radium bearing ores and also illustrated by lantern slides showing existing mines, etc.

It is expected that Mr. Howard's paper will be published in the Association Journal in the near future.

Adjourned.

Fred D. Ulmer, *Secretary.*

Civil Engineers' Society of St. Paul.

The regular monthly meeting of the Civil Engineers' Society of St. Paul was called to order by President Toltz in the Council Chamber at the City Hall, at 8:15 p. m., February 9, 1914. There were twenty-seven members and four guests present.

Minutes of the last meeting of the Society were read and approved.

Moved, seconded, and carried that the name of Mr. Geo. H. Geib, elected to membership at the regular meeting December 8, 1913, be, in accordance with his written request, dropped from the rolls of the So-

ciety until such time as he may again be employed in this city and able to attend our meetings.

Moved, seconded, and carried that the written resignations of W. W. Curtis, P. E. Stevens and M. D. Thompson be accepted.

Resignation of H. H. Harrison was read, but action was postponed until the next meeting to give further time to hear from him.

Reports (verbal) were given by the following Committee Chairmen: Geo. W. Rathjens, A. F. Meyer, Wm. Danforth, J. H. Mullen, Geo. H. Herrold and James E. Carroll, all for the special committees assigned to the investigation of special subjects.

Moved, seconded, and carried that the Secretary notify Mr. Wm. A. French that the Society is not yet ready to arrange for club room space in his building and that further negotiations for the present will cease.

President Toltz reappointed Mr. L. P. Wolff, representative of this Society on the Board of Managers of the Association of Engineering Societies.

President Toltz announced that he desired the members of the Society to consider the matter of legislation to put the Engineering Profession on a legal basis, so that at the next meeting consideration might be given to the appointment of a committee to formulate recommendations thereon.

Eleven applications for membership were received.

Illustrated lecture on "Triangulation Work in Arizona" was then given by Professor John T. Stewart of the Minn. Farm School. The Society tendered vote of thanks to Mr. Stewart.

Motion to adjourn, seconded, and carried, 10:30 p. m.

E. J. Dugan, *Secretary.*

The regular monthly meeting of the Civil Engineers' Society of St. Paul was called to order by President Toltz in the Council Chamber at the City Hall, at 8:15 p. m., March 9, 1914. There were thirty-eight members and twenty-two guests present.

Minutes of the last meeting of the Society were read and approved.

Moved, seconded, and carried that the name of Thos. E. Ward be dropped from the membership roll on account of delinquency in dues.

Notice given of proposed amendment to Article 16 of the Constitution for action at the next regular meeting, to require initiation fee with application for membership.

Moved, seconded, and carried, that Membership Cards be issued to members on payment of first half of annual dues, and to non-resident members on payment of annual dues.

Moved and seconded that the name of H. H. Harrison be dropped from the membership roll on account of delinquency in dues. Amendment to postpone action until next meeting to allow further time for hearing from Mr. Harrison, seconded and carried.

Moved, seconded and carried that the Secretary be instructed to cast the unanimous ballot of the Society for the election of the following applicants to full membership in the Society, all approved by the Examining Board:

R. W. Acton	311 Iglehart Ave	St. Paul
Wm. N. Carey	P. O. Box 654	St. Paul
J. T. Ellison	475 Laurel Ave	St. Paul
Paul C. Gauger	1183 Como Boulevard	St. Paul
Gates A. Johnson, Jr	1009 Ashland Ave	St. Paul
Walter E. Lord	2601 Humboldt Ave	Minneapolis
E. G. Minder	1694 Van Buren St	St. Paul
Victor H. Roehrich	1896 Feronia Ave	St. Paul
John T. Stewart	University Farm	St. Paul
Myrtus A. Wright	219 Fourth Ave	So. St. Paul

And for Junior Membership:

Harry S. Bronson	365 Robie St	St. Paul

Nine applications for membership were received and were referred to the Examining Board.

Report (verbal) by Geo. W. Rathjens for the Entertainment Committee.

Illustrated lecture on "The Detroit Tunnel" was then given by Mr. William Butler of Butler Bros., General Contractors.

Motion to adjourn, seconded, and carried, 10:40 p. m.

E. J. Dugan, *Secretary.*

Oregon Society of Engineers.

As a result of the annual election of officers of the Oregon Society of Engineers, the following men will serve the Society this year:

W. H. Graves	President
W. S. Turner	First Vice-President
W. H. Crawford	Second Vice-President
E. G. Hopson	Third Vice-President
Orrin E. Stanley	Secretary
Henry Blood	Treasurer

Directors	J. H. Morton	Term expires Feb. 1915
	Fred Hesse	Term expires Feb. 1915
	C. W. Bale	Term expires Feb. 1915
	F. A. Naramore	Term expires Feb. 1916
	Douglar W. Taylor	Term expires Feb. 1916
	H. L. Vorse	Term expires Feb. 1916
	T. M. Hurlburt	Term expires Feb. 1917
	Russell Chase	Term expires Feb. 1917
	J. P. Newell	Term expires Feb. 1917

Nominating Committee	Edw. A. Taylor
	Chester J. Hogue
	R. E. Kremers
	F. F. Henshaw
	C. A. Merriam
	S. P. Clark
	E. I. Cantine
	B. C. Ball

Orrin E. Stanley, *Secretary.*

At a meeting of the Executive Board of the Oregon Society of Engineers held February 11, 1914, besides the reading and approval of bills for the regular monthly expenses and those incurred by the Entertainment Committee for the Annual Dinner, President Graves announced the chairmen of committees for the year as follows:

John A. Rockwood	Membership
C. F. Blake	Library
J. H. Morton	Legislative
W. H. Crawford	Press
W. S. Turner	By-Laws
C. E. Condit	Programme
D. C. Henny	Public Relations

Mr. C. W. Bale was elected a member of the Executive Board to fill the vacancy caused by Mr. Schuchart's removal to New York City.

At the meeting of the Executive Board of the Oregon Society of Engineers held on January 26, 1914, President Graves acting upon a request of the Civil Service Commission of the City of Portland, appointed Mr. Henry, Mr. Weber and Mr. Hastings a committee to co-operate with the Commission in conduction of examinations of an engineering nature. This committee was authorized to call upon any other member of the Society for such help as might be necessary at any time.

The Annual Business meeting of the Oregon Society of Engineers was held in the Blue Room of the Multnomah Hotel, Monday Evening, February 2, 1914, at 6:00 p. m.

There were about sixty-five present, including guests, among whom were several ladies.

Mr. W. E. Coman and Mr. Franklin T. Griffiths were the principal speakers of the evening, and they told of the relation of Public Service Corporations to the Public, and their dependence upon engineers for the successful working out of many of the problems that have to be solved.

Mr. Campbell, President of the State University of Oregon, spoke of the work of the engineer in conserving the forces of nature with which Oregon has been so bountifully blessed, and Mr. H. V. Gates emphasized the necessity for engineers to be prepared to meet the emergencies that constantly confront them.

The reports of the officers and the result of ballots for officers for the ensuing year were read.

ORRIN E. STANLEY, *Secretary.*

Address of President Walter H. Graves Before the Oregon Society of Engineers at Their Annual Meeting, February 2, 1914.

Ladies and Gentlemen, Members of the Oregon Society of Engineers:

We have assembled to-night at our regular annual meeting which marks the beginning of a new and the fourth year of the existence of our organization.

It is perhaps cognate to the purposes of this annual reunion to enquire briefly as to our situation (both individually and collectively), in relation to such an association, not only to consider the reason for its existence, but to ascertain if there is sufficient justification for our efforts to maintain it.

In soliciting for new members among the unaffiliated engineers the question is often asked: "What is the purpose of the society?" or "What are the benefits to be derived from a membership in it?" and doubtless, among the members there are those who—especially about the time the annual dues become liable—pause to enquire of themselves whether they are receiving sufficient benefits from the society to warrant further affiliation. So that, it may be well at this time and in harmony with the occasion to consider these questions and get our bearings.

If there is any one lesson which has been taught and is being taught daily, and is emphasized by experience in every walk of life, it is the value of association, of co-operative and co-ordinate effort in whatever and all avenues of human endeavor. In political polity, in civic, in business, in industrial affairs and in practically every possible relationship, combination is the modern keynote. It is not only essential for effective results, but it is absolutely the *sine qua non* for the successful issue of the great majority of undertakings. The tendency in all directions is towards "big business," towards amalgamation, absorption and centralization. In the onrush of the "passing show" there is precarious footing for the individual who thinks he can maintain his position in the procession alone and unaided even though he may stand head and shoulders above his fellows. Occasionally there may be one, enjoying some peculiar prestige or operating from some especial vantage-point, who seems to hold his own single-handed, but if you keep your eye upon him for a while you will observe that he will be drawn under, sooner or later, in the swirl of the strife.

It is, therefore, becoming more and more a problem of how best to sustain an avocational footing and incidentally to survive individually, i. e. in the abstract and unidentified.

The lesson of association and the advantages of a community of interests, both for offence and defence, should be effectually impressed upon the mind of the average engineer by his experience with the vicissitudes and exigencies of his business, probably more peculiar to his profession than any other.

There are engineers who have been fortunately situated, who have good business connections and who enjoy a comfortable and a lucrative

practice and where this is the case it is generally the result of especial personal fitness and ability, but this is not always true and even exceptional qualifications cannot guarantee the perpetuation of a situation of this sort, so the best of us are liable to bump up against grim-visaged adversity at any turn of the road and it behooves the best of us to give serious consideration to the hazard of disastrous circumstance. Immunity from misfortune is not obtainable at any price.

With the average engineer, and even with those who have traveled but a short distance along the highway of life, experience goes to show that success, measured by whatever standards, is attained only by the exercise of unceasing vigilance and plodding industry, assisted and supported by every propitious accessory within reach.

Hence he cannot afford to ignore nor be indifferent to any agency affording the potential support as is offered by such an association as this organized to promote and forefend his means of livelihood. To the thoughtful engineer who is in the habit of working out his problems to their ultimate results and does not lose sight of the final analysis of things there must be sufficient and fundamental reasons for the existence of such an institution as the Oregon Society of Engineers and a full measure of tangible reasons for his participation in its activities.

In joining the society he would assume certain obligations. These may not be specifically stated nor communicated to him in any way, but he (the thoughtful engineer), will be quite conscious of them and of his responsibility in the matter.

He would be expected to contribute in every way within his power to the general uplift and advancement of the professional and ethical standards of engineering practice. He would be expected to contribute by the observance of the cardinal virtues of good citizenship and rectitude of character to a higher estimate and a more deserving respect for engineers in the popular mind.

He would be expected to affiliate with his fellow-members on the presumption that they were worthy and well qualified and entitled to receive from him at all times respectful and fraternal consideration. He would be expected to cultivate friendly relations and intercourse among his fellow-engineers and mingle with them in participating in the deliberations and activities of the society on the supposition that an interchange of ideas, views and experiences with them would be of mutual interest and benefit.

On the other hand, from such an affiliation he would be the beneficiary of the society's implied endorsement, a credential of character and ability which should be a valuable asset in the business and practice of any engineer.

Through the medium of the sessions and conventions of the society he has the opportunity for expressing and promulgating the results of his professional work and suitable occasion for enlarging and extending his sphere of influence and clientele.

It also gives him the opportuity of acquiring the habit of "mixing" (presumably an "open sesame" to business success), and cultivating the

faculty of adaptability while extending the radius of his opportunity and usefulness.

He is by acquired habit a crustacean and can never expand to full stature until he breaks out of and discards his limiting shell.

His chief circumscribing limitation arises, perhaps, from his disposition to encyst himself in his technicalities in whatever he undertakes. Persistently attempting to work out his destiny by logarithmic tables and mathematical formulae, and his social and business relations by the slide-rule—a professional sophistry largely responsible for his discomfiture.

The engineering business is essentially a competitive one. For every "engineering job" offered there are many equally competent competitors and the struggle is always keen and strenuous and in the strife for business there is apt to be engendered opposition and professional antagonisms which if allowed unrestrained expression lead to abiding animosities, and this state of affairs has heretofore characterized engineering practice to a large and regrettable degree. There is a marked tendency to relegate this distinguishing feature to the department of obsolesence. It was formedly supposed that *teeth* and *fangs* were indispensable adjuncts to an engineer's operating equipment, but happily these are now regarded as evidences of incompetency and ignorance.

The outcome of every competitive engagement means, of course, one successful and any number of disappointed contestants and the real *bona fide* engineer will always accept the result good naturedly, philosophically and like a genuine sportsman and not regard his successful competitor as a personal enemy thereafter.

Among the up-to-date engineers there is an evident disposition to engage in and conduct these competitions along well-recognized lines of professional ethics and high standards of fair dealing and good will so as to leave no aftermath of humiliation and ill feeling.

There is no agency or influence that is doing more to foster and promote this much-to-be-desired state of affairs than the various engineering societies.

Much more might be pertinently said as to the internal relations of the society, which is to say, the relations of the members to each other and to the profession, without exhausting the subject in any degree, but it would only be a supererogation at this time.

There is, however, another subject of equal, if not greater importance which comes strictly within the purview of the association, and that is our external relations, or our relations with the public. This subject readily resolves itself into two considerations; first, what do engineers, as a profession, owe to the public? and secondly, what does the public owe the engineering profession?

As to the first of these questions let us enquire. Is the engineering profession failing in any respect to measure up to the needs and requirements of the times? The demands upon the engineer in the development now under way in all the various fields of industry, commerce, mining, agriculture, etc., are certainly numerous, diversified and exacting—has he failed to respond to these demands? When we think of the magnitude, the intricacy and the importance of the interests and problems which

center about the engineer and the tremendous responsibilities he assumes without hesitation, devoting to his tasks absolutely his body, mind and soul, and when we try to measure the value of his achievements in conserving and improving the wellbeing, the proseprity, security and happiness of mankind, I am sure there can be no question as to his discharging his obligations to the public.

Now as to the manner in which he meets and acquits himself in his personal and individual account with the public is a matter in relation to which there may be radical differences of opinion.

If he meets with any measure of success at all in his professional work he must have acquired the habits of sobriety, decency, industry, truthfulness, loyalty, integrity and fair-dealing and fortified thus in the essentials of good citizenship he certainly can not be very delinquent in his accountability to the public.

While these fundamental elements of character are to a greater or less extent requisite to success in all callings they are determining pre-requisites to successful engineering.

There is, however, one problematical element in the makeup of the engineer which seems to appeal readily to the public mind and that is the question of his professional capability and the slightest whisper of criticism or animadversion will serve to befog the public mind and arouse a pronounced sentiment of distrust and disfavor against him, especially in connection with any public work or improvement.

The field of engineering is so extensive in its scope and embraces such a wide range of application that it is practically impossible for a man to become proficient, or to acquire even a working acquaintance with any number of the various departments of engineering accomplishment he is therefore compelled to concentrate his attention to one, or at least a few, lines of his professional pursuit if he becomes at all efficient or skillful, and he makes a serious mistake if he ventures into those branches of the calling with which he is unfamiliar. It is regrettable that eagerness in search for employment, or necessity, often impels him to invade an especial line of work with which he is not familiar, to his own downfall and the discredit of the profession generally.

It is one of the legitimate functions of the society to checkmate this sort of a liability by employing the "baffleplate" of professional disapprobation and it should be the duty of the members to become sufficiently acquained with each other and the lines of especial interest and practice followed by each so as to be able to assist and recommend each other to employers in search of men for especial kinds of work. It is unquestionably for our collective and professional advantage to have the right man in the right place to the mutual benefit and satisfaction of the engineer and his employer. It is also clearly within the province of the society not only to secure employment wherever possible for its members, but to proclaim in all proper ways their professional qualifications.

Reverting to the consideration of the converse question, as to what the public owes to the engineer, I am aware that we have in hand a matter that is decidedly "open for discussion"—perhaps as widely open

as the subject of a proper "engineering curricula" for the State universities—and I assure you there is a greater diversity of authoritative and peremptory opinion on the part of the less-informed public in regard to this latter subject than there is among the engineers. And it certainly is a peculiar state of affairs when "the butcher, the baker and the undertaker" et al., presume to sit in judgment as to what course of study and training is necessary to qualify a man to follow the business of engineering while the engineering profession is excluded from the public discussion and consideration of the subject.

The trouble over this matter seems to arise from a determination on he part of those who appear to be in position to dictate, to force upon the State institutions a system of matriculation calculated to turn out a type of ready-made engineers modeled to suit the requirements of the dictators as inexpensive and interchangable parts, handy and subservient to their business operations.

However, there are splendidly equipped engineering schools offering elective and unabridged curricula accessible to the ambitious student elsewhere, and as there are no compulsory educational laws in Oregon, there is no especial cause for alarm whatever may be the outcome of the present agitation.

Current engineering literature indicates a very prevalent dissatisfaction among engineers as to the status of their profession in the public mind, in contrast with other professions and callings.

There seems to be a very general tendency to subordinate the engineer in his public relationship. To regard him as an instrumentality rather than one of the component elements of the social structure. To regard him as "a necessary evil" and to be eliminated at the earliest possible opportunity, indispensable, perhaps, as a part of the paraphernalia, but in no particular one of the performers in the drama of life.

When we stop to consider the facts as they actually exist and realize the present-day situation in the evolution of the human race and contemplate the underlying forces and impulses that are bringing about the wonderful and stupendous transformations in practically every department of human welfare, it will not require a magnifying lens to discover the hand and the influence of the engineer in the moulding and shaping of it all. Surely his is no minor part in the act nor is he the understudy to any actor in the play.

Modern economic and industrial evolution, which is the real basis of the world's progress, seems to be under full headway and progressive achievement marks this as the most marvelous age in the history of the world. It is characterized by unprecedented and gigantic enterprises of all sorts and the creative and predetermining genius, the master-mind and the master-builder, is always the engineer. Then why should he be satisfied to accept a subordinate place at any time or in any respect in the affairs of mankind.

The engineering is really the most important of all professions and from it should be selected the leaders of men, the rulers in the realms of enterprise and business. The engineer should be the *employer* and not the *employe*. He should acquire the habit of *commanding* and eradicate

from his subconscious mind the idea that it is an essential part of his calling to learn to *obey* with grace and facility.

The aphorism that the world accepts us at our own estimate of ourselves is strikingly in evidence with the engineer and the seeming disparagement which we protest against is largely of our own creation or at least we are chiefly responsible for it.

It is a noteworthy fact that when a man is needed to take charge of any important matter, or as director or manager of any large institution or corporation he is seldom, if ever, selected from the engineering profession. It is popularly supposed that from any other calling or even from any of the ordinary walks of life a suitably equipped man for such a position and responsibility can be obtained without difficulty, but the same popular mind seems to take it for granted that the engineer is impossible, notwithstanding he may have designed and created that particular enterprise or institution.

Positions of executive responsibility require the faculty of comprehensive vision and generalization and habits of thought which transcend the concentrated contraction and minutia which characterizes the engineer's training.

There is another peculiar phase of public opinion which seems to be very prevalent and which is a serious handicap to the engineer and that is the popular prejudice against employing a local or resident member of the profession upon any public improvement or public utility work. The fact that he is a citizen and a property owner being *prima facie* evidence of his disqualification for such employment. This popular prejudice seems to extend also to private enterprise projects and undertakings, so that the local engineer is practically debarred from employment altogether in the locality in which he lives and is forced to search for it elsewhere and thus he is forced to migrate from place to place in the pursuit of occupation and in time he becomes a nomad and were it not for the sturdy and prophylactic character of his early training he might eventually become a vagabond.

There are still other inhibitions and hindrances to the profitable and satisfactory pursuit of his profession, but it is unnecessary to delve further into Pandora's Box in search for the ills that the engineering flesh is heir to, as we are all quite familiar with them both from experience and tradition, and it may be that they have become so embedded in his sub-consciousness that he unsuspectingly permits them to find expression in his material surroundings.

While engineers are arriving at a better understanding among themselves through the agency of their associations they are also coming to a better understanding of the possibilities and opportunities of their vocation as well as its drawbacks and they are manifestly developing a class-consciousness from the poignant necessity of some concerted and cohesive action in safeguarding their interests and also to open all possible avenues for professional employment and finally to educate the public to a more appreciative understanding of their prerogatives as in-

tegral parts of the communities in which they live and share in civic responsibility.

It has been said that when engineers learn to handle men and situations with th e same calculating skill with which they manipulate materials and forces they will enlarge the field of their activities and influence. As a predominating mental attitude finally manifests in material realization he needs to cultivate the habits and faculties of self-assertion and leadership and he will then speedily emancipate himself from the existing subjection to popular ignorance and prejudice.

In seeking remedial measures it is first necessary to know the nature and extent of the disorder. The next step is an accurate diagnosis and finally a vigorous course of restorative treatment.

Among the several objects and purposes for which the Oregon Society of Engineers was organized is that of contributing by every means within reason not only to professional uplift, but also to the eradication of vocational heresies, obstructing traditions, and—not less important—to assail aggressively the embarrassing proscripions of an obsessed popular opinion.

Surely this is a sufficient warranty for its franchise. It is not the intention of its membership to suspend any of its functions, waive any of its claims or to "mark time" while complacently awaiting the fortuitous consummation of hese ends or he mediation of a benevolent Providence.

Annual Report of the Secretary.

February 2, 1914.

To the Members of the Oregon Society of Engineers:

On this, the third anniversary of the founding of the Oregon Society of Engineers, it is well that we should take a look backwards to see if as much has been accomplished as might be reasonably expected of a society of that age.

The members, being for the greater part, busy men, find little time to devote to the interests of the Society; but by tireless effort on the part of a few, several others have been found who gave their time and energy for the preparation of papers for presentation at meetings, and for the accomplishment of a great deal of tedious work on various committees.

The work of the Programme Committee has been so arduous, in fact, that Mr. Vorse, who was chairman during the early part of the year, after a splendid record, found that he could not devote the required time to the work after June, and resigned. Mr. Grace and Mr. Crawford arranged for one of the most successful meetings in the history of the Society for the first meeting after the summer vacation. This was in the nature of a camp dinner, and was thoroughly enjoyed by about seventy-five members and their guests.

Mr. C. E. Condit was then appointed chairman of the Programme Committee and has carried on the very difficult and important work of that branch of the Society in a highly satisfactory manner.

As an experiment, the Annual Directory of members this year contains advertisements; and with all bills paid, we are about $100.00 ahead on the venture.

Our solicitor was too lenient with some, however; for one man declared after the booklet was printed, that the absence of his advertisement from its pages would cost him more than $1,000.00 this year. We consider this to be a first rate testimonial.

The advertisements are inexpensive, and furnish a good means for an engineer to call the attention of his fellows to those lines of endeavor in which he is specially proficient. I see no reason why this feature should not grow to be more and more profitable to the advertisers and to the Society each year.

Since discontinuing our connection with the Oregon Technical Club, we are again able to send the Journal of the Association of Engineering Societies to all members who have paid in advance. If there could be any way of knowing who would pay their dues later in the year, there would be no objection to sending the Journal to such members also; but these are troublesome times in the financial world, and the Society has felt the inconvenience of having been nearly stranded once, and does not wish to incur unnecessary risks. Therefore the sooner you pay your dues, the more you will get for your money.

The Journal promises to be even better than in the past, and each member can help to improve it by writing a paper on some subject with which he is particularly familiar for presentation to the Society.

We do not get much more out of our connection with a society than we put into it. If each of us were to remain at home on meeting nights with his feet resting comfortably before a red-hot stove, the meetings would be of little interest; but if all would attend, and show a desire to take part in the discussions, and would so pester the Programme Committee for dates that we would be forced to meet weekly to hear all the acceptable papers presented, the Society would be of untold value to all.

The Employment Department has been influential in placing several of the members in paying positions. It is not yet widely enough known to be of the greatest service.

Each member should be a booster for this branch of the work—tell everybody that the Secretary has on file a list of men who are open for offers of engagement. They are good men,—many are employed,—but are capable of better things than what they are now doing. Some are out of work and would be glad to take a minor position to tide them over a tight place. An inquiry is likely to bring you just the man you want for the work you have on hand. Or if you wish to change your position, the filing of your qualifications with the Secretary may be the means of placing you in work that you will enjoy, because you are adapted for it, and will pay you well because you can do it better than another.

Some attention was paid to a proposed code of ethics, earlier in the year, but some of us are naturally so good that we need nothing of

the kind, while others are afraid that it will interfere with our business methods, and so the discussion has faded away.

There was an enthusiastic meeting of about 5 per cent of the membership nearly a year ago, to consider a bill for the licensing of engineers in the State of Oregon. On account of the lack of a quorum no action was taken at that time, and the subject has never been revived.

The adoption of an emblem for the Society is another matter that sleeps peacefully on. Occasionally it turns over and yawns, but the soothing influence of the Executive Board soon quiets it again. It is "not dead, but sleepeth," and *some day* some one will fall upon just the right idea, and we will then have an emblem of which we'll all be proud. Until then, the members of the Oregon Society of Engineers will be distinguished from their fellows of the "great without" by their lofty brows, heavy purses and smiles of contentment caused by the knowledge that we are members of the biggest, best and busiest bunch of engineers that we know anything about.

ORRIN E. SANLEY, *Secretary.*

Information Regarding Membership and Payment of Dues in 1913.

January 31, 1914.

Membership on 1912 Directory:		
Active	231	
Juniors	23	
Associate	2	
Membership January 31, 1914:		Gain
Active	241	10
Juniors	53	30
Associate	3	1
Total	297	41
Members Elected February, 1913:		
Active	18	
Juniors	18	
Total		36
Members Elected July, 1913:		
Active	53	
Juniors	19	
Associate	2	
Total		74
		110
Lost by resignation and default of dues		69

PROPORTION OF MEMBERS WHO PAID DUES.

Members Elected in July:	
Active	88.5 per cent
Junior	47.5 per cent
Associate	100 per cent
Entire Membership:	
Active	80.5 per cent
Junior	66 per cent
Associate	100 per cent

New active members paid up somewhat better than the older membership.

Respectfully,

HENRY BLOOD.

Report of the Treasurer.

January 31, 1914.

To the President and Members of the Oregon Society of Engineers:

Complying with Section 5, Article X, of the Constitution, I beg to submit herewith my report showing the condition of the Treasury of the Oregon Society of Engineers for the year ending January 31, 1914, and indicating the sources of revenue and causes of expenditures:

Cash on Hand February 1, 1913		$ 220.82

RECEIPTS.

12 Dues—Active Members for year 1912 at $6.00	$ 72.00	
1 Dues—Active Members for balance 1912	3.00	
1 Dues—Junior Member for year 1912	3.00	
144 Dues—Active Members for year 1913 at $6.00	864.00	
47 Dues—Active Members elected in July at $3.00	141.00	
1 Dues—Active Member first half 1913	3.00	
21 Dues—Junior Members for year 1913 at $3.00	63.00	
5 Dues—Junior Members with Journal sub. at $4.50	22.50	
9 Dues—Junior Members elected in July at $1.50	13.50	
1 Dues—Junior Member first half 1913	1.50	
1 Dues—Associate Member for year 1913	10.00	
2 Dues—Associate Members elected in July at $5.00	10.00	
6 Dues—Active Members for year 1914 at $6.00	36.00	
1 Dues—Active Member partial for 1914	2.00	
3 Dues—Junior Members for year 1914 at $3.00	9.00	
1 Dues—Associate Member first half 1914	5.00	
		1,258.50
Paid Advertisements in Directory	$ 355.00	
Portion of Excursion Fund turned into Treasury	12.00	
One Subscription to Journal for 1913	2.50	
Refund from Oregon Tech. Club for Club Room Rent	11.46	
		380.96
Total credit for year		$1,860.28

EXPENDITURES.

Services of Margaret White as Secretary	$ 71.10	
Services of Secretary, Orrin E. Stanley, 7 mos	35.00	
Services of Secretary, Orrin E. Stanley, 2 mos	20.50	
Steongraphic work	70.10	
Stationery and Printing	165.14	
Printing Directory	108.80	
Office Rent, 605 Spalding Bldg., 2 mos	22.50	
Share of expenses in Archts. Club Rooms, 6 mos	270.00	
Stereopticon lantern for lectures, rental	18.00	
Postage	62.64	
Rent of chairs for one meeting	6.00	
Association of Eng. Societies, for Journal, etc	193.04	
Commission of Mr. Urquahart for soliciting ads	125.00	
Telegram to Col. Goethals Oct. 11, Gamboa Dyke	10.00	
Tech. Club luncheons, P. O. box rent and miscell	30.95	
		1,208.77
Balance, January 31, 1914		651.51
		$1,860.28

Eugene Excursion Special Fund.

Receipts.

25 Subscripions at $2.00	$ 50.00	
1 Subscription	2.45	
		$ 52.45

Expenditures.

Cash book and receipt blanks	$ .45	
Letters, notices, etc.	8.95	
Postage	6.89	
Telegrams and telephone messages	2.55	
Printing badges	16.85	
Refreshments	12.50	
Railroad fare, W. D. B. Dobson	3.60	
		51.79
Balance		.66
		$ 52.45

This fund was kept in a separate account, and bills paid directly therefrom, until $40.45 had been expended, at which time the balance of $12.00 was turned into the Treasury. The remaining bills were paid in the usual manner.

Account With Bank.

Cash on hand February 1, 1913	$ 220.82	
Deposits during year	1,457.46	
		$1,678.28
Disbursements by check	$1,083.77	
Balance in bank January 31, 1914, as per statement	594.51	
		1,678.28
Checks on hand, not yet deposited	$ 57.00	57.00
Commission of solicitor for advertising, retained by him and not turned into bank		125.00
Total balance	$ 651.51	
Total credit		$1,860.28

Actual Receipts of Society, All Sources.

Dues	$1,258.50	
Subscriptions for Excursion to Eugene	52.45	
Advertisements in Directory	355.00	
One subscription to Journal	2.50	
		$1,668.45
Cash on hand February 1, 1913		220.82
		$1,889.27

Actual Expenses.

Eugene Excursion	$ 51.79	
Use of Archts. Club Rooms for 6 mos.	258.54	
Other items as in general report	927.43	
		$1,237.76
Balance January 31, 1914		651.51
		$1,889.27

The difference between the itemized statement and account with bank is due to the fact that the solicitor of advertising retained his commission, and it did not pass through the bank; also that only $12.00 of the Excursion Fund was turned into the bank.

The difference between true receipts and apparent receipts was caused by the fact that $270.00 was paid to the Oregon Technical Club for use of the Architects' Club Rooms, and after accounts were closed

$11.46 was refunded to the Society as its share of the balance. Also by carrying a separate account for the Excursion Fund.

During the year ending January 31, 1913, the expenditures exceeded the receipts by $89.97. During the past year the Society has spent $430.69 less than the receipts. This is due to the fact that the use of the Architects' Club was discontinued, the office in the Spalding Bldg., not rented after April, much clerical and correspondence work performed by the Secretary gratis, and the use of a lecture room in the Public Library obtained free.

Respectfully submitted,

HENRY BLOOD, *Treasurer.*

The Engineers' Club of St. Louis.

The 753d meeting of the Club was held in the Club Rooms, Wednesday, December 3, 1913, 8:15 p. m. President Hunter presided. There were present forty-eight members and three visitors. This was the Annual Business Meeting.

The minutes of the 749th, 750th, 751st and 752nd meetings were read and approved and the minutes of the 538th meeting of the Executive Commitee were read.

A vote of thanks was extended to the Fulton Iron Works and the Electric Company of Missouri for courtesies extended to the Club on its recent visit.

Additional nominations for officers for 1914 were made by a petition signed by twenty-four members as follows: H. C. Toensfeldt for President; J. E. Allison for First Vice-President; E. L. Ohle for Second Vice-President; George Johns for Secretary; E. C. Dicke for Treasurer; C. W. Martin for Librarian; J. J. Lichter and J. T. Dodds for Directors.

The annual reports of the President and Chairman of the Executive Committee, of the Secretary and of the Treasurer were read. The report of the Librarian was not received in time to be presented but was submitted for publication. The reports of the Meetings and Papers Committee, the Membership Committee, the Entertainment Committee, the Members of the Board of Managers, the New Quarters Committee, and the Committee on the Constitution and Incorporation were read:

On motion the report of the Committee on the Constitution and Incorporation was accepted and filed and the Committee discharged.

Mr. E. R. Fish offered the following resolution:

"Whereas the Circuit Court of the City of St. Louis, Missouri, on the 11th day of November, 1913, duly granted and entered a Decree of Incorporation incorporating the Engineers' Club of St. Louis,

"And whereas a charter was issued to the Engineers' Club of St. Louis by the Secretary of State, of the State of Missouri, on the 14th day of November, 1913, constituting said the Engineers' Club of St. Louis a corporation,

"Now, therefore, be it resolved that the charter of the Club be adopted. Be it further resolved that the charter and the constitution be recorded in the minutes of this meeting and that following the record of the charter and the constitution that all the names of the members of the Engineers' Club of St. Louis at the time of incorporation be enrolled, and that all of said members shall henceforth be legal members of this corporation, the Engineers' Club of St. Louis."

Said resolution after having been put to a vote was unanimously adopted, the said charter and articles of agreement or constitution of the Club are attached to these minutes, and the members thereof at the time of the adoption of said articles of agreement and the issuance of the charter as aforesaid being and are those listed in the roll of members prepared for publication in the Nineteenth Annual Bulletin, omitting the names of five members which the records show were elected November 25, 1913, and eight who shall be elected on December 22, 1913.

Mr. C. W. Martin, for the Committee on the Reinforced Concrete Column, reported progress.

Mr. J. W. Woermann, for the Committee on the Mississippi River Levee Work, presented resolutions as given in the report hereto attached.

On motion of Mr. Richard Morey, amended by Mr. A. S. Langsdorf, the report was received and the resolutions adopted and the Secretary was instructed to inform the proper authorities of the Club's action.

Mr. F. C. Woermann presented a progress report of the Committee on Revision of the Building Code of the City of St. Louis.

Mr. J. A. Laird, as delegate to the National Conservation Congress, gave an informal account of the work of the Congress.

It was voted that a special committee be appointed or that the Executive Committee act to prepare resolutions recommending the appointment of an Engineer to one of the vacancies on the Interstate Commerce Commission and to transmit the resolutions to the proper authorities.

The proposed amendments to Section 12 of the by-laws, referring to the nomination of officers, were discussed. On motion the matter was referred to a special committee to be appointed, which should consider all suggestions made and prepare a by-law for presentation to the Club.

The matter of the recommendation of the Executive Committee that the Initiation fee be suspended for the first four months of 1914 was discussed and it was ordered that a proposed amendment to the by-laws permitting suspension of the initiation fee be mailed to the membership before the next meeting.

Adjourned 10:45 p. m.

W. W. Horner, *Secretary.*

The 754th meeting of the Club and Associated Societies was the Annual Dinner held at the City Club, December 17, 1913, 7:00 p. m. The meeting was called to order by retiring President John Hunter. There were 131 persons present.

The ballot for officers for 1914 was announced by Secretary W. W. Horner, as follows:

President	Albert P. Greensfelder
First Vice-President	John W. Woermann
Second Vice-President	Edwin D. Smith
Secretary	Wesley W. Horner
Treasurer	William E. Rolfe
Librarian	W. E. Bryan
Directors	Herman Spoehrer Walter S. Ashton

The programme consisted of an address by retiring President John Hunter, the installation and address of President A. P. Greensfelder and talks by Messrs. C. P. Walbridge and John L. Messmore. Mr. Joseph W. Peters, the new Assistant Secretary, was introduced and made a few remarks. Past President M. L. Holman and Captain Robert W. Hunt were called upon. Mr. J. D. Von Maur delivered a very interesting and amusing talk with reference to the retiring administration. A self-appoined committee consisting of Messrs. E. H. Abadie, R. Toensfeldt, Geo. McD. Johns, J. C. Pritchard, and W. E. Rolfe, presented a formal report at some length on matters pertaining to the welfare of the Club, the Association of Engineering Societies, the Engineering Profession, the Municipal Free Bridge and Humanity in General.

Adjourned 11:00 p. m.

W. W. Horner, *Secretary.*

The 755th meeing of he Club was the New Year's eve reception held in the Club Rooms, Wednesday, December 31, 1913. President Greensfelder called the meeting to order. There were present about 100 members, their wives and friends.

Having been designated "Past Presidents' Night," President Greensfelder yielded the chair to Senior Past President M. L. Holman. Past Presidents Holman, F. E. Nipher, J. A. Ockerson, J. H. Kinealy, W. A. Layman, E. R. Fish, J. D. Von Maur and A. S. Langsdorf were present.

Mr. G. Alexander Wright, President of the Technical Society of the Pacific Coast, one of the guests of the evening, made a short talk on "Better Estimating Methods and Quantity Surveying."

There were a number of short talks followed by moving pictures and dancing.

Joseph W. Peters, *Assistant Secretary.*

The 756th meeting of the Club was held in the Club Rooms, Wednesday, January 7, 1914, 8:15 p. m. President Greensfelder presided. There were present thirty-six members and nine visitors.

The minutes of the 753d, 754th and 755th meetings were read and approved. The minutes of the 540th, 541st and 542nd meetings of the Executive Committee were read.

Motion carried to lay over until the next regular meeting the proposed amendment to the by-laws.

Motion carried to authorize the President to appoint three members of the Club as a committee to consider, with the Contractors and Architects, the subject of "Quantity Surveying."

Mr. John A. Ockerson presented a paper on the "Status and Duty of the Engineer," which was a reply to a paper on the "Status of the Engineer," presented in September by Mr. Edward E. Wall. A discussion followed by Messrs. Robert Moore and J. W. Woermann, and a reply by Mr. Edward E. Wall. Further discussion was participated in by Messrs. M. L. Holman, C. E. Smith, S. Bent. Russell, Philip Moore, H. H. Humphrey, Prof. J. L. Van Ornum, Mont. Schuyler, Edw. E. Wall and J. A. Ockerson.

Adjorned 10:15 p. m.

Joseph W. Peters, *Assistant Secretary.*

The 757th meeting of the Club was held in the Club Rooms, Wednesday, January 21, 1914, 8:15 p. m., as a joint meeting with the A. I. E. E. President Greensfelder called upon Chairman F. J. Bullivant, of the A. I. E. E., to preside. There were present twenty members and twenty-four visitors.

Mr. Hugo Wurdack presented a paper on the "Special Features of Power Plant Equipment of the Railway Exchange Building." Discussion followed by Messrs. John Hunter, E. D. Smith, J. A. Whitlow, F. J. Bullivant, C. A. Hobein, Jr., W. E. Bryan, E. H. Tenney, H. H. Humphrey, J. B Van Vleck, and others.

Mr. William Bradford presented a paper on "Power Plant Equipment of the Laclede Gas Light Co." Discussion followed by Messrs. W. E. Bryan, C. A. Hobein, Jr., H. Wurdack, John Hunter, H. H. Humphrey, H. J. Elson, F. E. Bausch, and others.

Adjourned 9:45 p. m.

Joseph W. Peters, *Assistant Secretary.*

The 758th meeting of the Club was held in the Club Rooms, Wednesday, January 28, 1914, 8:15 p. m., as a joint meeting with the A. S. C. E., A. S. M. E., A. I. E. E., and A. S. E. C. President Greensfelder presided. There were present forty-four members and thirty-five visitors. This was an open meeting, all interested having been invited.

Mr. Charles M. Talbert, Street Commissioner of the City of St. Louis, presented an illustrated paper on "Traffic Regulations." Discussion followed by the Honorable Kiel, Mayor of St. Louis, and Messrs. J. D. Von Maur, J. H. Gunlach, Carl Hawkins, J. A. Gerk, T. Walton, J. W. Woermann, Mayor Giederman of Webser Groves, Mo., and G. McD. Johns.

Adjourned 11:00 p. m.

Joseph W. Peters, *Assistant Secretary.*

The 759th meeting of the Club was held in the Club Rooms, Wednesday, February 4, 1914, 8:15 p. m., as a joint meeting with the A. S. M. E. President Greensfelder called the meeting to order. There were present thirty-three members and twenty-two visitors.

The President called for the reading of the proposed amendment to the by-laws. The amendment was read, amended and carried as follows:

(Insert between the second and third sentences of Section 10.)

"The Executive Committee may suspend dues, either current or delinquent, whenever in the case of a particular member the enforcement of the above provisions for payment or dropping of a delinquent member would work a hardship on a member otherwise in good standing or would result to the disadvantage of the Club."

The proposed amendment of Section 15 of the by-laws was defeated.

President Greensfelder called upon Chairman F. E. Bausch, of the A. S. M. E., to preside.

Mr. J. R. Lyle of New York City presented an illustrated paper on "Air Conditioning."

Adjourned 11:00 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

The 760th meeting of the Club was held in the Club Rooms, Wednesday, February 18, 1914, 8:15 p. m., as a joint meeting with the A. S. C. E., A. S. M. E., A. I. E. E., and A. S. E. C. President Greensfelder presided. There were present twenty-eight members and seven visitors.

The minutes of the 756th, 757th, 758th and 759th meetings of the Club were read and approved. The minutes of the 543rd and 544th meetings of the Executive Committee were read.

Motion made and seconded that the Secretary be instructed to send at once the following statement of fact to the Committee of the Municipal Assembly, to the Business Men's League and to every daily paper in St. Louis with the request that this statement in fairness to the public and to our Club be given the same prominence and publicity as has been given to other recent statements involving the name of the Engineers' Club in connection:

"The Engineers' Club of St. Louis has never indorsed any scheme nor any report on any scheme for an approach to the Municipal Bridge, nor is anyone authorized to speak on this subject, for or on behalf of the Engineers' Club of St. Louis."

Motion carried that in view of the small amount of information before the Club at this time concerning this matter that it be laid on the table.

Mr. S. T. Henry, Western Manager of the *Engineering Record,* presented an illustrated paper on the "Making of a Technical Journal." Discussion followed by Messrs. J. W. Woermann, Mont. Schuyler, W. E. Rolfe, A. P. Greensfelder, S. W. Bowen, C. A. Hobein, Jr., E. A. Garrett, C. W. Martin and J. B. Van Vleck.

A vote of thanks was extended to Mr. Henry.

Adjourned 10:30 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

The 761st meeting of the Club was held in the Club Rooms, Wednesday, February 25, 1914, 8:15 p. m., as an informal smoker and general

welfare meeting. President Greensfelder presided. There were present sixty-four members and six visitors.

The programme of the evening consisted of progress reports by chairmen of the various committees and a general discussion of Club affairs. About twenty topics were offered for discussion, a number of which brought out keen discussion, particularly the one touching on the Library.

The President called upon members who were elected to membership in the Club in the year 1884, thirty years ago. There followed a number of very interesting talks by the members celebrating their thirtieth anniversary. Mr. E. D. Meier elected to membership in 1872 delivered an interesting talk on the Club and engineering in those days.

Adjourned 11:30 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

The 762nd meeting of the Club was held at the City Club, Friday, February 27, 1914, 6:30 p. m., as a dinner to Henry M. Waite, City Manager of Dayton, Ohio. President Greensfelder presided. There were present sixty members of the Engineers' Club, twenty especially invited guests and sixty-seven members of the City Club.

After dinner had been served Mr. Waite delivered a very interesting talk on "The Engineer as an Executive and the New City Manager Plan of Dayton, Ohio." The following gentlemen contributed to the discussion which followed: E. R. Kinsey, Max. Reber, Julius Pitzman, Dr. A. R. Hill, W. A. Layman, Philip Moore and J. W. Woermann.

Adjourned 9:00 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

The 763rd meeting of the Club was held in the Club Rooms, Wednesday, March 4, 1914, 8:15 p. m., as a joint meeting of the Associated Engineering Societies under the auspices of the A. S. C. E. President Greensfelder called upon Chairman John W. Woermann, of the A. S. C. E., to preside. There were present fifty-six members and four visitors.

Mr. Edward E. Wall, Water Commissioner of the City of St. Louis, presented an illustrated paper on the "Chain of Rocks Filters." About twelve members contributed to the discussion which followed.

Adjourned 10:15 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

The 764th meeting of the Club was held in the Club Rooms, Wednesday, March 18th, 1914, 8:15 p. m. President Greensfelder presided. There were present thirty members and nineteen visitors.

The minutes of the 760th, 761st, 762nd and 763rd meeting of the Club were read and approved. The minutes of the 545th and 546th meeting of the Executive Committee were read.

Professor E. O. Sweetser of Washington University presented an illustrated paper on "Impact Stresses in Railway Bridges." A discussion followed by Messrs. M. L. Holman, Carl Gayler, Mr. Hudson, C. W. Martin, S. W. Bowen and L. C. F. Metzger.

Adjourned 10:30 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

ASSOCIATION OF ENGINEERING SOCIETIES

Vol. 52. MAY, 1914. No. 5.

PROCEEDINGS.

Technical Society of the Pacific Coast.

San Francisco, January 26th, 1914.

Meeting of the Society held at the residence of the Secretary, 1726 Broadway, San Francisco.

Past President George W. Dickie in the chair.

The Secretary read the minutes of the last regular meeting and made a verbal explanation of the present standing of the Society.

A general discussion followed.

Upon motion the following Nominating Committee was appointed to select a ticket of officers for the ensuing year, and the Secretary was instructed to communicate with the Chairman and the members of this Committee: Marsden Manson, Chairman; Herman Barth, L. S. Griswold, Charles E. Ker, Carl Uhlig.

The meeting thereupon adjourned.

Otto von Geldern, *Secretary.*

Regular Meeting Held March 6, 1914

The meeting was called to order by President G. Alexander Wright.

The minutes of the last regular meeting were read and approved.

The Nominating Committee had made its report to the Board of Directors, and placed in nomination the following ticket for officers to serve during the ensuing year:

For President..........G. Alexander Wright
For Vice-President..........Professor Hermann Kower
For Secretary..........Otto von Geldern
For Treasurer..........Adolph Lietz

For Directors..........Hermann Barth, George W. Dickie, Harry Larkin, Hermann Meyer, Henry A. Schulze

This ticket was circulated to members by mail, and the returned ballots were ready to be opened and counted.

The President appointed Mr. Larkin and the Secretary as tellers to open the returned ballot envelopes.

It was reported that thirty-five ballots were received and that the vote showed a unanimous choice for the ticket as chosen by the Nominating Committee. The President thereupon declared the following officers as duly elected to serve the Technical Society during the year 1914-1915:

Mr. G. Alexander Wright	President
Professor Hermann Kower	Vice-President
Mr. Otto von Geldern	Secretary
Mr. Adolph Lietz	Treasurer

Directors	Mr. Hermann Barth Mr. George W. Dickie Mr. Harry Larkin Mr. Hermann Meyer Mr. Henry A. Schulze

The Secretary thereupon made the following general report:

This Society is not only a component of the Association of Engineering Societies, with its headquarters at St. Louis, but it is likewise affiliated with the Pacific Association of Scientific Societies, which has, at the present time, sixteen local organizations of a scientific character that make up the Association.

The Pacific Association has set its Annual Meeting for May 21-23, 1914, which is to be held in Seattle on Puget Sound. The Technical Society is expected to take part in this meeting, and the Secretary, Professor J. N. Bowman, of the University of Washington, has personally interviewed the officers and members of the Pacific Northwest Society of Engineers, which is a flourishing organization in Seattle, and it has been made known to the Secretary that this Society is very anxious to have the Technical Society in Seattle in May, and there is no doubt that a very hearty welcome will be extended to our members if they go.

The following letter shows this, and your Secretary would recommend that some action be taken on this letter:

PACIFIC NORTHWEST SOCIETY OF ENGINEERS.

"Seattle, February 27, 1914.

Mr. Otto von Geldern,
865 Pacific Building,
San Francisco, Cal.

My Dear Sir:

"Will you please let me know, as soon as possible, whether or not

the Technical Society will meet in Seattle this summer? If so, about when and how many would be in attendance?

"I desire to present this information to the Board of Directors of the Pacific Northwest Society of Engineers at its meeting on March 7th, 1914.

"Thanking you for your trouble, I remain,

Very truly yours,

(Signed) Jesse A. Jackson, *Secretary.*"

Your Secretary has answered this letter as follows:

"San Francisco, March 2, 1914.

Mr. Jesse A. Jackson, Secretary,
Pacific Northwest Society of Engineers,
312 Central Bldg.,
Seattle, Wash.

My Dear Sir:

"In answer to your letter as to the probability of a meeting of the Technical Society in Seattle this Summer, I beg to reply as follows:

"The Technical Society is a component of the Pacific Association of Scientific Organizations, and the Annual Meeting of this Association will be held in Seattle about the middle of May. (May 21-23.)

"The program for this meeting will be made in due time, after it is known definitely how many of the components will participate.

"The Technical Society has a local meeting next Friday, and the question of this annual meeting in Seattle, and the Society's participation in it will be brought up. In going so far away, the participation becomes a matter of individual ability to go. Times have been hard on engineers here of late, and the plethora of the pocketbook has to be carefully considered. I have no doubt that a number of members will go, but how many, that is something which I cannot now tell you. In order to get at this definitely, the membership will have to be canvassed, and this will take at least a week or ten days after our next meeting, March 6th.

"But, even there be only a limited number, rest assured that we shall be greatly pleased to meet our colleagues, and that we shall certainly enjoy a visit to our engineering brethren on Puget Sound.

"I shall write you again.

"With my personal regards to you and to the members of the Society, I am,

Faithfully yours,

(Signed) Otto von Geldern, *Secretary.*"

The President thereupon suggested that immediate action be taken; upon motion it was ordered that the membership of the Society be canvassed at an early date to ascertain the probable number of participants.

The Secretary suggested that the canvass be deferred long enough to find out from the transportation companies and hotels the probable expense of the trip, in order to make his statements to members definite. This was agreed upon.

The Secretary thereupon continued his report as follows:

The headquarters of the Association of Engineering Societies were transferred from Boston to St. Louis at the beginning of the present year. The present Secretary is Mr. J. W. Peters of 3817 Olive Street. The Technical Society has been in correspondence with him since his election to office, and the principal subject of discussion has been the necessity of supplying the Journal with technical papers for publication. This may be gathered from the following letters:

ASSOCIATION OF ENGINEERING SOCIETIES,

Office of the Secretary,

3817 Olive Street, St. Louis, Mo.

January 30, 1914.

"Mr. Otto von Geldern, Secretary,
Technical Society of the Pacific Coast,
San Francisco, Cal.

My Dear Mr. Secretary:

"I wish to take this opportunity to inform you that we are in the need of papers for publication in the Journal and request that you send to me as soon as possible any copy you may have for publication.

"As it is my desire to keep in close touch with the constituent societies of the Association, will you kindly place my name on your mailing list?

Yours very truly,
(Signed) J. W. Peters, *Secretary*."

TECHNICAL SOCIETY OF THE PACIFIC COAST.

San Francisco, February 3, 1914.

Mr. Joseph W. Peters, Secretary,
Association of Engineering Societies,
3817 Olive St.,
St. Louis, Mo.

My Dear Sir:

"As soon as Mr. G. Alexander Wright, the President of the Technical Society, returns from his recent trip to New York, which will be in a day or two, for he is now in Los Angeles, the matter of manuscript papers for publication will be taken up.

"We have not made up our program for this year, owing to Mr. Wright's absence.

"There will be a meeting of the Pacific Association of Scientific Societies, of which the Technical Society is a local member, and this meeting is to be held in Seattle, Washington, on May 21-23 of this year. There will probably be papers read then before the Technical Society as a section, and these papers will be sent to you for publication in the Journal. It is this program which has not been arranged as yet as to individual authors.

"The last year's program was published in the Journal and the Technical Society's principal paper was that on "World's Projections," by Mr Cahill.

"I enclose a letter head showing the component Societies of the Scientific Association.

"Is it not possible for you people to outline some sort of a project for our Exposition Year, 1915? Many engineers from all parts of the world are to visit San Francisco then, and, presumably, there will be "something doing" in circles technical.

"I have put your name on our mailing list as requested.

Yours very truly,

(Signed) OTTO VON GELDERN, *Secretary.*"

Another organization, which has an international fame, is making an effort to obtain a direct foothold on the Pacific Coast, where it has members but no organized office or representation.

It is the American Association for the Advancement of Science. Mr. C. E. Grunsky and your Secretary attended a meeting at the Faculty Club of the University of California, as Committeemen last week, to consider the possibility of merging the Pacific Association of Scientific Societies into the great American Association.

On this subject your Secretary has received the following letter from Mr. Albert L. Barrows, who is the Associate Secretary here:

UNIVERSITY OF CALIFORNIA.

Berkeley, February 24, 1914.

"Mr. Otto von Geldern, Secretary,
Technical Society of the Pacific Coast,
San Francisco.

My Dear Mr. von Geldern:

"The American Association for the Advancement of Science is making plans for a large convention to be held in San Francisco in August, 1915. We are desirous of coming into touch with all those men on this Coast who are interested in scientific affairs, in order to offer to them the advantages of membership in the American Association and to secure their co-operation in advancing the success of the 1915 Convention.

"May I ask you to send me a list of the members of the Technical Society of the Pacific Coast, and if you can send me such a list, I shall have it copied and shall return it to you if you desire.

"I am glad to write to you about this because I feel sure of your interest in the success of the 1915 Convention, and I believe that the ex-

pansion of the work of the American Association on this Coast will be of very great benefit to our scientific organizations.

"Let me thank you in advance for your courtesy in this matter.

Very truly yours,

(Signed) ALBERT L. BARROWS, *Associate Secretary,*
American Association for the Advancement of Science..

It shows that there has been some activity and with a proper spirit this activity may be worked up into an enthusiasm.

Now, as to the Technical Library. You will remember that this Society took an interest in the matter of creating a great technical library on the Pacific Coast, and, in its capacity as an advisor, it communicated with the Board of Trustees of the Mechanics' Institute.

Your Secretary is pleased to state that this Board took up this important subject with its usual thoroughness. The librarian (Mr. Graves) will leave for the East to visit the great technical libraries, for the purpose of studying them and obtaining information. It is the plan of the Institute to start this library work at once by the systematic purchase of books on a big scale. For this purpose the office of a special technical librarian will be created, whose duty it shall be to establish, maintain and develop a library of which all engineers on the Pacific Coast may be proud. This is not the result of an idle conversation or a talked of project, but it is a materialized plan, which has all arrangements made for the librarian's visit to the East. Upon his return the matter will take definite shape. It is one of the policies of the Mechanics Institute, and it was announced as such by the President of the Institute at its Annual Meeting last evening."

The members thereupon discussed the subjects touched upon, and the Secretary was empowered to proceed in all matters that had been brought up at this meeting.

It was further agreed that hereafter all meetings of the Society be held on Thursday evening instead of on Friday, because of the inability of several of the officers to attend.

The President, Mr. Wright, thereupon read a paper of great interest to architects and engineers, entitled: "The Quantity System of Estimating as the Basis for Building Contracts." The author went into his subjects very thoroughly, having had this matter in mind for a long time, and a general discussion followed the reading of the paper which brought out items of interest.

This paper was ordered to be sent to the Secretary of the Association for publication.

In the matter of the lamentable death of our fellow-member, Frank P. Medina, the Secretary was instructed to send the obituary notice, written by a friend of the family, to the Journal for publication.

OTTO VON GELDERN, *Secretary.*

The Oregon Society of Engineers.

Regular monthly meeting of the Oregon Society of Engineers in the East Side Public Library, April 9, 1914, at 8:00 p. m.

The meeting was called to order by President Graves who introduced Mr. J. T. Whistler, the first speaker.

Mr. Whistler's subject was "The Co-operation of the State With the U. S. Government in Irrigation Works," and he handled it in a very able manner, telling in an interesting way the history of some of the projects in Oregon and the neighboring States.

He stated that unless additional appropriation were made by Congress, it might be necessary before long to discontinue the practice of conducting irrigation investigations in the various States in the "dollar for dollar" plan now in use.

Mr. John H. Lewis was the next speaker, having for his subject, "The Work of the State Engineer."

Mr. Lewis gave a very comprehensive history of the work of the office of the State Engineer of Oregon, from the time that the office was created by the Legislature. This he is quite competent to do, as he has held the office from the first.

He spoke particularly about the abuse of rights granted under the *Carey Act* by unscrupulous promoters.

In the discussion of his paper he said that it is the purpose of the State to not only co-operate with the U. S. Government in the securing of data regarding irrigation projects, but to get information from the railroads and from private interests throughout the State.

Mr. Fred F. Henshaw followed Mr. Lewis with a fine collection of lantern slides showing the status of stream gauging in Oregon, and showing as well, the instruments and methods used in this country and abroad in this work.

Upon being questioned by Mr. M. E. Reed as to the possibility of using an automatic recording device for current meters, Mr. Henshaw gave it as his opinion that such an attachment would be a hindrance to the quick and easy use of the meters, and would therefore be undesirable.

Mr. Graves called attention to the fact that there is in Oregon a much greater area of timbered and logged off land waiting to be reclaimed, than the total area of arid land that can be possibly put under water, and gave it as his opinion that in the near future, this land will be re-

claimed at a profit, this profit to be made from by-products such as turpentine, charcoal, resin, etc.

Leupold and Voelpel exhibited a Stevens continuous Water Level recording device such as is in use at several stream gauging stations in the Northwest.

After a rising vote of thanks to the speakers, the meeting adjourned.

ORRIN E. STANLEY, *Secretary.*

The Engineers' Club of St. Louis.

The 765th meeting of the Club was held in the Club Rooms, Wednesday, March 25, 1914, at 8:15 p. m. First Vice-President J. W. Woermann presided. There were present 56 members and 15 visitors.

Mr. Carl Gayler, Consulting Civil Engineer, presented a paper on "City Charters in General and Our New City Charter in Particular." The discussion which followed was led by Mr. Edw. Flad and participated in by Messrs. Edw. E. Wall, C. M. Talbert, E. R. Kinsey, S. Bent. Russell, W. S. Mitchell, J. D. Von Maur, H. Pfeifer, F. G. Jonah, H. A. Wheeler, J. Pitzman and W. L. Jones.

Adjourned 10:45.

JOSEPH W. PETERS, *Assistant Secretary.*

The 766th meeting of the Club was held in the Club Rooms, Wednesday, April 1, 1914, 8:15 p. m., as a joint meeting of the Associated Engineering Societies of St. Louis under the auspices of the A. S. E. C. Mr. James Adkins, Jr., Chairman of the A. S. E. C., presided. There were present 35 members and 3 visitors.

Mr. Nelson Cunliff, Superintendent of Construction, St. Louis Park Department, presented an illustrated paper entitled "The Cost Keeping of the St. Louis Park Department."

Adjourned 10:30.

JOSEPH W. PETERS, *Assistant Secretary.*

The 767th meeting of the Club was held in the Club Rooms, Wednesday, April 8, 1914, 8:15 p. m., as a party meeting with the A. I. E. E. Chairman F. J. Bullivant of the A. I. E. E. presided.

Mr. A. H. Timmerman, Chief Engineer of the Wagner Electric Manufacturing Co., presented an illustrated paper entitled "Motor and Generator Equipment for Automobiles."

Adjourned 11:00.

JOSEPH W. PETERS, *Assistant Secretary.*

The 768th meeting of the Club was held in the Club Rooms, Wednes-

day, April 15, 1914, at 8:15 p. m. President Greensfelder presided. There were present 35 members and 17 visitors.

The minutes of the 764th, 765th, 766th and 767th meetings of the Club were read and approved. The minutes of the 547th, 548th and 549th meetings of the Executive Committee were read.

A motion by Mr. W. E. Rolfe, seconded by Mr. W. W. Horner, that the Club adopt the Regulations of theAssociated Engineering Societies of St. Louis, as printed in Club Bulletin No. 3, was carried in the affirmative.

The Assistant Secretary read the report of the Public Affairs Committee, signed by its Vice-Chairman Mr. W. S. Mitchell, containing recommendations of the Committee with reference to the New City Charter. Motion by Mr. W. W. Horner, seconded by Mr. W. E. Rolfe, that the report be referred to Mr. Edward Flad, member of the Club on the Board of Freeholders, as a report of the work of the Committee. Motion to amend by Mr. H. C. Toensfeldt, seconded by Mr. W. F. Hendrich, that the report be printed and referred to the Club in the form of a referendum ballot was lost (Rising vote, 10 to 17.) A vote was then taken on the original motion and it was carried in the affirmative.

Recommendation by Mr. H. A. Wheeler that the Club express its appreciation in the form of a letter to the Mayor of St. Louis commending the manner in which the administration is handling the present selection of a Commissioner of Sewers referred to the Committee on Public Affairs.

There being no further business before the meeting the President called upon Mr. L. R. Bowen who presented the paper of the evening entitled "The Twelfth Street Viaduct." Mr. A. R. Ross read a discussion prepared by Mr. C. W. Martin. Mr. Winters Haydock read a paper further contributing to the paper by Mr. L. R. Bowen. The papers were profusely illustrated. Further discussion was participated in by Messrs. S. W. Bowen, Carl Gaylor, P. A. Richardson and A. P. Greensfelder.

A rising vote of thanks was extended the speakers.

Adjourned 10:45 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

The 769th meeting of the Club was held in the Club Rooms, Wednesday, April 22, 1914, 8:15 p. m., as a joint meeting of the Associated Engineering Societies of St. Louis under the auspices of The Engineers' Club of St. Louis. President Greensfelder presided. There were present 30 members and 13 visitors.

Mr. Walter O. Pennell, Equipment and Building Engineer, Southwestern Bell Telephone Company, presented a paper on "The Value of 'Present Worth' Calculations in Engineering Studies."

Discussion followed, participated in by Messrs. W. C. Swartout, C. E. Brenton, John Hunter, H. F. Merker, C. L. Jennings, J. D. Von Maur,

C. A. Hobein, Jr., J. B. Van Vleck, A. P. Greensfelder, S. Stokes and C. A. Renard.

Adjourned 10:30 p. m.

JOSEPH W. PETERS, *Assistant Secretary.*

Association of Engineering Societies

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PROCEEDINGS.

Oregon Society of Engineers.

Portland, Oregon, May 13, 1914.

At a special meeting of the Oregon Society of Engineers, held in Room "A" of the Public Library Building, Portland, Ore., Monday evening, May 4, 1914, Mr. Ralph Modjeski delivered a lecture on "The New Quebec Bridge."

The lecture was admirably illustrated by means of lantern slides, showing drawings of the bridge, and photographs of the progress of the work from the beginning under the present commission to the present time.

Mr. Modjeski has been a member of the new Quebec Bridge Commission since it was appointed in 1907, being the only member of the original commission now serving, and was therefore able to give a very interesting account of the investigations, experiments and the actual work of construction.

Comparisons were made between the bridge now being erected and the old one, as well as with the Forth Bridge of Scotland. A much smaller wind load is being assumed than for the Forth bridge. A device for measuring the pressure of wind per square foot, at right angles to the sides of the trusses has been erected near the site of the bridge, and records are being kept. Though these results will be made known too late to change the design of the present structure, they will show whether or not the assumptions of the designers were correct, and will be of great use in the design of future bridges which will be subject to high velocities of wind.

The method of testing the gravel foundation of one of the piers was explained, and views were shown of the damage to one of the large caissons and the work of repairing it.

A picture was shown of an enormous ice jam reaching from one of

the main piers to the other, which Mr. Modjeski says was withstood by the new and partially completed masonry without apparent damage.

The probable time of completion of the structure was given as 1917, or four more seasons of six months each.

Much of the work of assembling the bridge is done in the shops, and the pieces are shipped to the site of the bridge in as large sections as possible to handle. This is on account of the scarcity of labor of this class in Canada.

Orrin E. Stanley, *Secretary.*

The Engineers' Club of St. Louis.

The 771st meeting of the Club was held in the Club Rooms, Wednesday, May 6, 1914, at 8:15 p. m. Members of the St. Louis Architectural Club were guests of the evening. President Greensfelder opened the meeting and then called upon past president E. R. Fish to preside. There were present 26 members and 10 visitors.

The minutes of the 770th meeting of the Club were read and approved. The minutes of the 550th meeting of the Executive Committee were read.

The presiding officer then introduced Mr. Arthur T. Morey, of the Commonwealth Steel Company, Chairman of the National Council for Industrial Safety, who delivered a very interesting and instructive lecture on Industrial Safety and what can be accomplished along this line in other industries. The lecture was illustrated by 150 lantern slides.

Messrs. E. R. Fish, John Hunter, J. D. von Maur, M. O'Brien, W. C. Huning, H. Spoehrer, G. R. Wadleigh and E. B. Morgan contributed to the discussion which followed.

Adjourned 11:00 p. m.

Joseph W. Peters, *Assistant Secretary.*

The 772nd meeting of the Club was held at the City Club, Wednesday, May 13, 1914, at 6:30 p. m., as a dinner party and entertainment, and designated as Ladies' Night. President Greensfelder presided. The total attendance was 120.

There were short addresses by Mrs. Philip N. Moore on the coming St. Louis Pageant and Mr. Mont. Schuyler on the work of the St. Louis Art League, followed by comic readings by Mr. Gustavus Tuckerman, a travesty on the technical paper by Mr. W. E. Rolfe and a dance feature.

The following prize winners were announced in the contest for making the best suggestion for our next Ladies' Night: Mrs. Philip N. Moore, first prize, year's subscription to three periodicals; Mrs. A. S. Langsdorf, second prize, year's subscription to two periodicals; Elizabeth S. Schuyler, third prize, year's subscription to one periodical.

Adjourned 11:00 p. m.

Joseph W. Peters, *Assistant Secretary.*

Civil Engineers' Society of St. Paul.

St. Paul, Minnesota, April 13, 1914.

The regular monthly meeting of the Civil Engineers' Society of St. Paul was called to order by President Toltz, in the Society Rooms at the Old State Capitol Building, at 8:20 p. m.

There were 28 members and 3 guests present.

Minutes of the last meeting of the Society were read and approved.

Moved, seconded, and carried that resignation of H. H. Harrison, of Stillwater, Minn., be accepted.

Moved, no second, discussed, the appointment of a committee to obtain additional subscribers to the Journal of the Association of Engineering Societies. Motion lost.

Moved, seconded, and carried, that the Engineers' Club of Trenton, Trenton, New Jersey, be placed on our list for exchange of house and library privileges.

Moved, seconded, and carried, that the Western Society of Engineers, Chicago, Ill., be placed on our list for exchange of house and library privileges.

Moved, seconded, and carried, that delegates be appointed to represent this Society at the following: Sixth National Conference on City Planning, Toronto, May 25-27; National Drainage Congress, Savannah, Ga., April 22-25; Irrigation Congress.

Moved and seconded, that the Society Constitution be amended by adding after the first sentence of Article 14 the following: "Applications for membership shall be accompanied by an initiation fee, which shall be $5.00 for a member, $3.00 for a junior, and $2.00 for an associate." Also to strike out all of Article 16. After full discussion the vote resulted as follows: Yeas, 3; Nays, 24. Motion lost.

Verbal report for the Entertainment Committee by Geo. W. Rathjens.

Verbal report for the Building Code Committee by Geo. W. Rathjens.

Moved, seconded, and carried, that the Secretary cast the unanimous ballot of the Society for the election of the following applicants to full membership in the Society, all approved by the Examining Board:

Frank Le Roy Brown	695 Sherbourne Ave.,	St. Paul.
Arthur S. Devor	997 Laurel Ave.,	St. Paul.
C. Walter Johnson	2254 Carter Ave.,	St. Paul.
John W. Kelsey	632 St. Peter St.,	St. Paul.
Ernest E. Meier	710 Pioneer Bldg.,	St. Paul.
Chas. L. Motl	1502 Hague Ave.,	St. Paul.
Edward S. Nelson	715 Capital Bank Bldg.,	St. Paul,
W. P. Stevenson	Minot, N. Dak.	
J. J. Wilson	2266 Carter Ave.,	St. Paul.

Seven applications for membership were received and were referred to the Examining Board.

Mr. Roscoe L. Smith, Engineer for the Water Department of the

City of St. Paul, then read a paper on "The St. Paul Water Works.' A map of the water supply watershed was exhibited for reference during the reading of the paper.

Motion to adjourn, seconded, and carried, 10:25 p. m.

EDWARD J. DUGAN, *Secretary.*